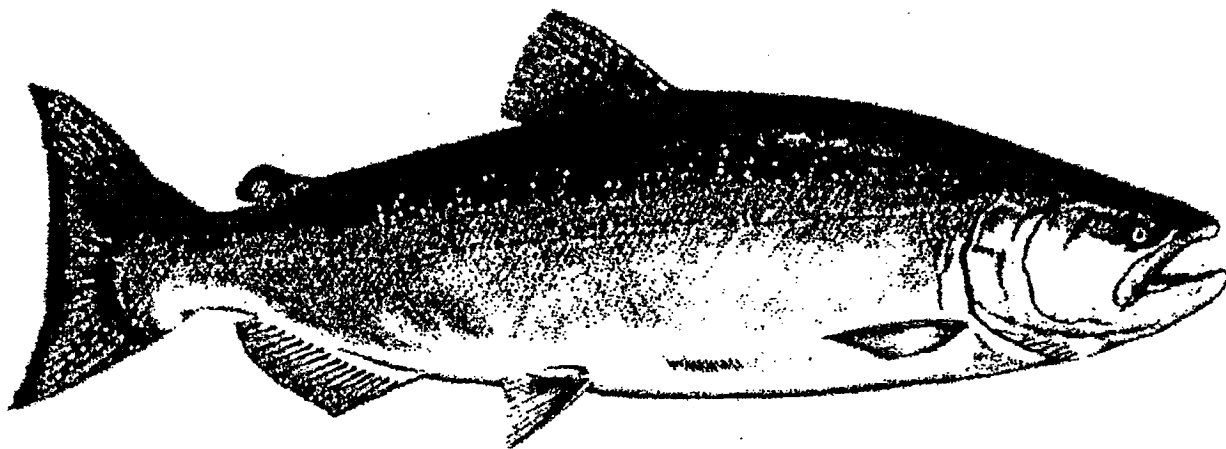


State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

**STATUS OF ACTIONS TO RESTORE CENTRAL VALLEY
SPRING-RUN CHINOOK SALMON**

A SPECIAL REPORT TO THE FISH AND GAME COMMISSION



Inland Fisheries Division
February 1, 1996

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ACRONYMS AND ABBREVIATIONS

AFRP	Anadromous Fish Restoration Program
BLM	Bureau of Land Management
CVP	.....	Central Valley Project
CVPIA	.....	Central Valley Project Improvement Act
CDFG	.....	California Department of Fish and Game
CDWR	.....	California Department of Water Resources
CEQA	.....	California Environmental Quality Act
CNFH	.....	Coleman National Fish Hatchery
CSUS	.....	California State University, Chico
DCC	.....	Delta Cross Channel
EPA	.....	Environmental Protection Agency
FERC	.....	Federal Energy Regulatory Commission
FGC	.....	Fish and Game Commission
GCID	.....	Glenn-Colusa Irrigation District
IEP	.....	Interagency Ecological Program
LMMWC	.....	Los Molinos Mutual Water Company
NBS	.....	National Biological Survey
NEPA	.....	National Environmental Policy Act
NMFS	.....	National Marine Fisheries Service
OPS Group	.....	CALFED Operation Group
PPMC	.....	Pacific Fishery Management Council
PG&E	.....	Pacific Gas and Electric
RWQCB	.....	Regional Water Quality Control Board
SWRCB	.....	State Water Resources Control Board
TCCA	.....	Tehama-Colusa Canal Authority
TNC	.....	The Nature Conservancy
USACOE	.....	U.S. Army Corps of Engineers
USBR	.....	U.S. Bureau of Reclamation
USFS	.....	U.S. Forest Service
USFWS	.....	U.S. Fish and Wildlife Service
USGS	.....	U.S. Geologic Survey
WCB	.....	Wildlife Conservation Board

STATUS OF ACTIONS TO RESTORE CENTRAL VALLEY SPRING-RUN CHINOOK SALMON

SUMMARY

This report provides a concise listing of the status of 166 habitat restoration projects, administrative actions, and evaluation studies that have been identified as necessary to protect, maintain, and restore spring-run chinook salmon populations in the Central Valley. These actions are located within 13 geographic areas (Table 1). The information contained herein is from two primary sources: *Restoring Central Valley Streams: A Plan For Action* (California Department of Fish and Game, 1993¹) and the *Draft Anadromous Fish Restoration Plan: A Plan to Increase Natural Production of Anadromous Fish in the Central Valley of California* (U.S. Fish and Wildlife Service, 1995²). Copies of these reports are available from the respective agencies (see footnotes).

Funding a comprehensive spring-run chinook salmon restoration program is a significant concern as the Department of Fish and Game (Department) has only limited discretionary funding to direct toward habitat restoration, administrative actions, and evaluations. As a result, the funding, implementation, and ultimate success of this important restoration effort will rely heavily on other existing and developing programs such as the U.S. Fish and Wildlife Service's (USFWS) Anadromous Fish Restoration Program (AFRP) and the Anadromous Fish Screening Program, both authorized by the Central Valley Project Improvement Act (CVPIA); two agreements between the Department and the Department of Water Resources and the U.S. Bureau of Reclamation to compensate for the loss of juvenile chinook salmon at the State and Federal Delta pumping facilities; and the Category III program resulting from the Principles of Agreement on Bay-Delta water quality standards.

Delta habitat conditions influence the survival of juveniles and return of adult spring-run chinook salmon and potential improvements in the Delta will rely heavily on management decisions by the Governor's Water Policy Council of the State of California and the Federal Ecosystem Directorate through the CALFED Framework Agreement.

Long-term measures, particularly in the Delta, will be closely linked to the CALFED Bay-Delta Program which is developing a comprehensive approach to long-term solutions to habitat problems in the Bay-Delta estuary. In recognition of the serious problems facing the region and the complexity of resource decisions that must

¹ California Department of Fish and Game, Inland Fisheries Division, 1416 Ninth Street, Sacramento, California 95814

² U.S. Fish and Wildlife Service, Central Valley Fish and Wildlife Restoration Program, 2800 Cottage Way, Room E-1831, Sacramento, California 95825

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be made, the State of California and the federal government are developing this long-term plan to stabilize, protect, restore, and enhance the Bay-Delta Estuary. These actions will greatly assist in protecting and restoring Central Valley populations of spring-run chinook salmon.

In addition to listing actions necessary for spring-run chinook salmon protection, this report presents information regarding opportunities to implement a comprehensive restoration program through existing and developing ecosystem management programs in the Central Valley. All these developing programs rely heavily on establishing effective partnerships and collaborative efforts with local landowners, stakeholders, interest groups, and other local, state, and federal agencies. Support of the local landowners is a particularly important element in the Department's program to protect and restore spring-run chinook salmon.

TABLE 1. List of Locations and Types of Habitat Restoration Actions Necessary to Protect and Restore Spring-run Chinook Salmon in the Central Valley. (Numbers in parentheses indicate active or completed projects).

Stream or Area	Number of Actions			
	Habitat Restoration	Administrative Action	Evaluation Study	Total Projects
Sacramento River	13 (12)	6 (5)	7 (6)	26 (23)
Antelope Creek	0	0	8 (3)	8 (3)
Battle Creek	4 (1)	4 (4)	3 (2)	11 (7)
Big Chico Creek	3 (2)	7 (5)	4 (4)	14 (11)
Butte Creek	6 (3)	13 (5)	11 (7)	30 (15)
Clear Creek	3 (1)	2 (2)	2 (2)	7 (5)
Deer Creek	5 (4)	8 (6)	4 (2)	17 (12)
Feather River	0	0	1 (0)	1 (0)
Mill Creek	1 (0)	5 (5)	6 (5)	12 (10)
Yuba River	6 (5)	7 (3)	5 (1)	18 (9)
Sacramento-San Joaquin Delta	0	5 (5)	11 (11)	16 (16)
Central Valley-wide	0	1 (1)	3 (3)	4 (4)
Ocean	0	0	2 (2)	2 (2)
Total	41 (28)	58 (41)	67 (48)	166 (117)

Summary

PERSPECTIVE

Spring-run chinook salmon represent a significant biological legacy of Pacific salmon populations and are an important element of the biodiversity associated with Central Valley rivers and streams. Although spring-run chinook salmon were historically abundant, low population sizes in recent years have led to serious concerns regarding the ability of this chinook salmon stock to persist into the future. The following table lists the tributaries and major river systems above the mouth of the Feather River which are presently known or thought to either have sustaining populations of spring-run chinook, are presently capable of supporting populations of spring run, or have some historical reference as having supported spring-run chinook (Table 2).

Spring-run chinook enter Sacramento River tributary streams from late February through June. Early arriving adults hold in cool water habitats through summer, then spawn in the fall. Spawning occurs from mid-August through early October with the peak in September. Fertilized eggs generally incubate from mid-August through mid-March, with rearing and emigration of fry and smolts beginning in late November and continuing through June. A significant migration of yearlings from upper tributary watersheds also occurs in September through March of the following spring.

Within the Sacramento River drainage, spring-run chinook salmon existed above most of the major dam sites including the stream reaches above: Shasta Dam on the Sacramento River; Oroville Dam on the Feather River; Englebright Dam on the Yuba River; Folsom Dam on the American River; and Stony Gorge Dam on Stony Creek (Figure 1).

Prior to the construction of dams and hydropower projects, spring-run chinook were spatially and temporally separated from the fall-run chinook, which served to maintain genetic isolation of both races. The widescale elimination of access to headwater areas forced many populations of spring-run chinook into close or overlapping proximity with fall-run chinook. Generally, the accessible low elevation stream reaches below newly constructed dams did not provide suitable cold water holding and incubation temperatures and the populations disappeared. Several locations, however, provided adequate water temperatures for spring-run chinook after the dams were constructed and operational. The main stem Sacramento River below Keswick Dam and the Feather River below the fish barrier dam each provided cool water and spring-run chinook populations continued to return annually. Since the time of dam construction, the spawning times for these two spring-run chinook populations gradually extended later into the season and now overlap with fall-run chinook spawning. As a result, the Department has collected substantial evidence which indicates that the two races have intermixed, but the extent of hybridization has not been quantified. Genetically uncontaminated spring-run chinook may still exist in Deer and Mill creeks where they are generally geographically and temporally separated from

TABLE 2. Spring-run Chinook Salmon Stocks, Status of Population, Stock Purity, and Potential for Restoration.

Spring-run Chinook Stock	Status of Population		Stock Purity	Potential for Restoration
	Present	Sustaining		
Deer Creek	Yes	Yes/Declining ^{1/}	Yes	High
Mill Creek	Yes	Yes/Declining ^{1/}	Yes	High
Butte Creek	Yes	Yes/Declining ^{1/}	Yes	High
Battle Creek ^{2/}	Sporadic	Sporadic	Questionable ^{3/}	High ^{4/}
Big Chico Creek	Sporadic	No	Questionable ^{3/}	Moderate
Clear Creek	No	No	Questionable ^{3/}	Moderate ^{4/}
Sacramento River	Sporadic	Sporadic	No	Low
Antelope Creek	Sporadic	No	Questionable ^{3/}	Low
Cottonwood Creek	Sporadic	No	Questionable ^{3/}	Low
Feather River	Yes	Yes	No	Unknown
Yuba River	Sporadic	Sporadic	Questionable ^{3/}	Unknown
Cow Creek	No	No	No	None
Thomes Creek	No	No	No	None

^{1/} Population trend data for Deer, Mill, and Butte creeks indicate declining populations since the early 1970s. These three populations are sustaining, and Butte Creek recently had the highest return of spawners ever observed.

^{2/} The area of interest on Battle Creek is presently the 20 mile stream reach from the mouth upstream to Eagle Canyon Dam. Future consideration will be given to the 4 mile stream reach above Eagle Canyon.

^{3/} The purity of these stocks is listed as questionable due to either past introductions of hatchery produced spring-run chinook salmon or a lack of genetic knowledge of the parentage of spawning fish.

^{4/} The comprehensive evaluation of the potential to establish viable spawning populations of spring-run chinook salmon in Battle and Clear creeks has not been completed. Additional evaluations are needed of intragravel water temperatures during the incubation period, and water temperature data in the adult holding areas for dry, normal, and wet years.

fall-run chinook. Additional uncontaminated populations may be present in other important tributaries such as Butte Creek.

Spring-run chinook salmon are a renewable resource that can be successfully returned to levels of abundance within the presently limited available habitat. Spring-run chinook salmon restoration must focus on the streams which presently support viable spawning populations. In the short-term, maintaining and improving habitat

conditions in the important tributary streams and providing increased protection for young fish in the main stem Sacramento River and Delta will be the key to success.

The primary focus of restoration includes improving migration flows for adults and juvenile life stages which allow access to the important holding, spawning, and rearing areas found in Mill, Deer, Butte, and Battle creeks (Table 2). Although Battle Creek has not recently produced spring-run chinook salmon, present and near-term future measures directed at habitat restoration, improved flows, and the critical evaluation of water temperature data will be key elements in determining whether spring-run chinook salmon can be restored in Battle Creek. The headwater reach above Eagle Canyon is the most valuable area that will likely contribute to restoring spring-run chinook salmon. Likewise, restoration of Clear Creek may provide for yet another population of spring-run chinook salmon. Restoration efforts are underway for both of these potentially important streams, but, if feasible, establishing self-sustaining spring-run chinook populations may take 15 to 20 years.

The importance of the Yuba River population of spring-run chinook salmon has not been adequately assessed. Depending on the size of the endemic population, Yuba River spring-run chinook salmon could be an important component in the overall restoration program. However, Yuba River spring-run chinook salmon may have interbred with fall-run chinook due to the same causal factors as observed on the main stem Sacramento River and the Feather River.

Restoration of spring-run chinook salmon in Antelope Creek and Cottonwood Creek is a low priority as it will require extensive improvements in the long-term to provide sustainable benefits. Restoration of spring-run chinook salmon in the main stem Sacramento River is a low priority due to the probable hybridization of spring-run and fall-run chinook stocks. Presently, no restoration opportunities for spring-run chinook salmon exist on Cow or Thomes creeks, nor do we have proof that Cow, or Thomes creeks ever supported sustainable spring-run chinook salmon populations even though a few strays have been observed in some years.

In addition to maintaining and restoring high quality holding, spawning, and rearing habitat in the critical tributary streams, actions need to be implemented throughout the inland range of adult and juvenile spring-run chinook. Additional critical areas include the main stem Sacramento River from Keswick Dam to Chipps Island and the Sacramento-San Joaquin Delta. Adults use these areas for migration to the summer holding areas and juveniles use the areas for extended rearing and migration to the ocean.

Finally, ocean harvest rates of Central Valley spring-run chinook salmon stocks need to be examined to determine if harvest strategies for commercial and sport ocean fisheries are consistent with the overall spring-run chinook salmon restoration program.

**MECHANISMS FOR SUCCESSFUL IMPLEMENTATION OF THE CENTRAL VALLEY
SPRING-RUN CHINOOK SALMON RESTORATION PROGRAM.**

Spring-run chinook salmon represent a highly valued biological resource in the Central Valley. The continued existence of spring-run chinook salmon is closely linked to overall ecosystem integrity. Due to its life history requirements, typical of all Pacific salmon, spring-run chinook salmon require high quality habitats for migration, holding, spawning, egg incubation, emergence, rearing, and emigration to the ocean. These diverse habitats are still present throughout the Central Valley. The quality and accessibility of the habitats was diminished by human-caused actions, but can be restored to a very limited extent through a logical program that strives to restore or repair habitat elements on a systematic basis.

Habitat management and restoration require substantial and consistent funding to be effective. In addition, habitat restoration needs in the Central Valley are so diverse, that a single entity cannot succeed in this arduous task. Successful spring-run chinook salmon restoration will require the participation of federal, state, and local agencies, as well as the participation of interested parties, private landowners, conservation groups, and other land and water management groups.

Several existing programs should provide a springboard for the spring-run chinook salmon restoration program. These programs include the Central Valley Project Improvement Act (CVPIA); the agreements between the California Department of Water Resources (CDWR) and the Department of Fish and Game (Four Pumps Agreement), and between the U.S. Bureau of Reclamation (USBR) and the Department (Tracy Pumping Plant Agreement) to fund and implement habitat restoration actions in the Central Valley; and the Category III program resulting from the "Principles For Agreement on Bay-Delta Standards Between the State of California and Federal Government." These four funding sources are discussed in further detail.

Central Valley Project Improvement Act

The CVPIA has great potential to facilitate the successful implementation of many restoration actions needed to protect and restore spring-run chinook salmon. The CVPIA requires the Secretary of the Interior to implement a wide variety of Central Valley Project (CVP) operation modifications and structural repairs in the Central Valley for the benefit of the anadromous fish resources. Sections 3406(b)(1) through (21) of the CVPIA authorize and direct the Secretary, in consultation with other state and federal agencies, Indian tribes, and affected interests to take the following actions, all of which will ultimately assist in protecting and restoring spring-run chinook salmon:

3406(b)(1)(A) - Modify CVP operations to protect and restore natural channel and riparian values

3406(b)(1)(B) - Modify CVP operation based on recommendations of the USFWS after consultation with the CDFG.

- 3406(b)(2) - Manage 800,000 acre-feet of CVP yield for fish, wildlife, and habitat restoration purposes after consultation with USBR and CDWR and in cooperation with the CDFG.
- 3406(b)(3) - Acquire water to supplement the quantity of water dedicated for fish and wildlife water needs under (b)(2), including modifications of CVP operations; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land.
- 3406(b)(4) - Mitigate for Tracy Pumping Plant operations.
- 3406(b)(5) - Mitigate for Contra Costa Pumping Plant operations.
- 3406(b)(6) - Install temperature control device at Shasta Dam.
- 3406(b)(7) - Meet flow standards that apply to CVP.
- 3406(b)(8) - Use pulse flows to increase migratory fish survival.
- 3406(b)(9) - Eliminate fish losses due to flow fluctuations of the CVP.
- 3406(b)(10) - Minimize fish passage problems at Red Bluff Diversion Dam.
- 3406(b)(11) - Implement Coleman National Fish Hatchery Plan and modify Keswick Dam Fish Trap.
- 3406(b)(12) - Provide increased flows and improve fish passage and restore habitat in Clear Creek.
- 3406(b)(13) - Replenish spawning gravel and restore riparian habitat below Shasta Reservoir.
- 3406(b)(14) - Install new control structures at the Delta Cross Channel and Georgiana Slough.
- 3406(b)(15) - Construct, in cooperation with the State and in consultation with local interests, a seasonally operated barrier at the head of Old River.
- 3406(b)(16) - In cooperation with independent entities and the State, monitor fish and wildlife resources in the Central Valley.
- 3406(b)(17) - Resolve fish passage and stranding problems at Anderson-Cottonwood Irrigation District Diversion Dam.
- 3406(b)(19) - Reevaluate carryover storage criteria for reservoirs on the Sacramento and Trinity rivers.
- 3406(b)(20) - Participate with the State and other federal agencies in the implementation of the on-going program to mitigate for the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant.
- 3406(b)(21) - Assist the State in efforts to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions.

In addition to the aforementioned CVPIA actions, Section 3406(e)(1 through 6) directs the Secretary to investigate and provide recommendations on the feasibility, cost, and desirability of implementing the actions listed below. When completed, these actions will provide additional understanding of the overall ecosystem

problems and provide additional measures which will benefit spring-run chinook salmon.

- 3406(e)(1) - Measures to maintain suitable temperatures for anadromous fish survival by controlling or relocating the discharge of irrigation return flows and sewage effluent, and by restoring riparian forests.
- 3406(e)(2) - Opportunities for additional hatchery production to mitigate the impacts of water development and operations on, or enhance efforts to increase Central Valley fisheries: PROVIDED, that additional hatchery production shall only be used to supplement or to re-establish natural production while avoiding adverse effects on remaining wild stocks.
- 3406(e)(3) - Measures to eliminate barriers to upstream and downstream migration of salmonids.
- 3406(e)(4) - Installation and operation of temperature control devices at Trinity Dam and Reservoir.
- 3406(e)(5) - Measures to assist in the successful migration of anadromous fish at the Delta Cross Channel and Georgiana Slough.
- 3406(e)(6) - Other measures to protect, restore, and enhance natural production of salmon and steelhead in tributary streams of the Sacramento River.

Section 3406(g) of the CVPIA directs the Secretary to develop models and data to evaluate the ecologic and hydrologic effects of existing and alternate operations of public and private water facilities and systems to improve scientific understanding and enable the Secretary to fulfill requirements of the CVPIA.

Habitat restoration actions not directly addressed in the aforementioned actions, such as restoration measures on streams tributary to the Sacramento River, will be managed by the AFRP of the USFWS. Section 3406(b)(1) of the CVPIA directs the Secretary to develop and implement a program which makes all reasonable efforts to ensure that, by the 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991. The AFRP released its draft restoration plan in December 1995, and, similar to the Department's restoration plan released in 1993, the USFWS plan contains a listing of actions deemed necessary to protect and restore anadromous fish including spring-run chinook salmon in the Sacramento Valley.

An important attribute of the CVPIA is that Section 3407 established in the Treasury of the United States the "Central Valley Project Restoration Fund". Funds up to \$50,000,000 per year are authorized to be appropriated to the Secretary to carry out program, projects, plans, and habitat restoration, improvement, and acquisition. The funds are derived by payments from Central Valley Project water and power users.

Agreement Between the Department of Water Resources and the Department of Fish and Game to Offset Direct Fish Losses in Relation to the Harvey O. Banks Delta Pumping Plant (Four Pumps Agreement)

This significant agreement between the Departments of Water Resources and Fish and Game has proven to be an mutually beneficial program to protect and restore habitat for anadromous fish, particularly for chinook salmon. The agencies, through the Four Pumps Agreement, have successfully designed and implemented several important measures to benefit spring-run chinook salmon on Mill and Deer creeks. Funding is available through this agreement on a project-by-project basis. Projects that provide quantifiable benefits to spring-run chinook salmon, within specified cost benefit analyses, are generally approved for funding.

Agreement to Reduce and Offset Direct Fish Losses Associated with the Operation of the Tracy Pumping Plant and Tracy Fish Collection Facility (Tracy Agreement)

This agreement between the USBR and the Department provides a mechanism to identify, develop, and implement habitat restoration measures for anadromous fish in a manner similar to the Four Pumps Agreement. Presently, Tracy Agreement funding is being used to develop environmental documentation and permitting for the Western Canal Siphon Project on Butte Creek. This multimillion dollar siphon project will greatly improve the upstream and downstream passage of spring-run chinook salmon by removing several dams that impede migration and allow the consolidation and screening of diversions which will benefit juvenile spring-run chinook as they rear in and emigrate from Butte Creek.

Category III

The "Principles For Agreement on Bay-Delta Standards Between the State of California and Federal Government" called for the development of a program of so-called "Category III" measures. Category I and II measures address water quantity and water operations while Category III measures addressed non-flow related habitat issues. The "Principles" provide for funding of Category III activities estimated to be \$60,000,000 annually (for three years), to be secured through a combination of federal and state appropriations, user fees, and other sources. It was further agreed and urban and agricultural water suppliers will work with State and Federal agencies and environmental interests in an open process to determine project priorities and financial commitments for the implementation of Category III measures. Presently, only \$10,000,000 is available through this program, well short of the identified need of \$180,000,000.

Other Considerations

Interagency, Multidisciplinary Restoration Team. In addition to the availability of funding, the implementation of restoration measures requires significant redirection of existing staff to fully identify restoration projects, develop project proposals, complete feasibility studies, conduct preliminary and final engineering, accurately estimate total project costs, develop the appropriate National Environmental Policy Act (NEPA) or California Environmental Quality Act (CEQA) documentation and acquire environmental permits, issue and administer construction contracts, and conduct post-project monitoring and evaluations.

A developing opportunity for habitat restoration project implementation is through the creation of an interagency, multidisciplinary habitat restoration team comprised of fishery biologists, ecologists, hydrologists, engineers, habitat specialists, contract administrators, and clerical staff representing the Department, USFWS, National Marine Fisheries Service (NMFS), CDWR, USBR, and other interested entities. The program may be developed under direction of the AFRP of the USFWS.

Partnerships. The Department cannot succeed in its mission to protect and restore spring-run chinook salmon without establishing, maintaining, and nurturing strong partnerships with the diverse interests serving the needs of the Central Valley. We must establish firm, open partnerships with other State, Federal, and local agencies, and private property owners, interested parties, and stakeholder groups to effectively meet the challenges in managing and restoring spring-run chinook salmon population in the Central Valley. It is essential these partners understand the underlying concepts of habitat protection, enhancement, and restoration and that they participate in the development of projects to restore spring-run chinook salmon. Any habitat restoration program directed at Central Valley spring-run chinook salmon must not only meet the requirements of the Department but must also meet the needs of our "partners".

Role of Watershed Conservancies. Successful implementation of measures on privately owned land to protect, restore, and enhance habitats for spring-run chinook can be facilitated by close coordination and communication with newly established and forming watershed conservancies in the Central Valley. The principle value of these groups is to establish a desire within the private property owners for maintaining responsible stewardship of the land and its biological resources. Fish and wildlife management agencies assist conservancies by providing essential engineering and biological advice. The Department and others may even implement projects on private land at the request and in collaboration with the landowners. Leadership and direction, however, ultimately lies with those who own and live on the land. With this type of partnership and cooperative arrangement, solutions are maximized and potential conflict minimized.

The essence of the Conservancy movement is captured by the following quotes from the Deer Creek Watershed Conservancy:

Deer Creek Watershed Conservancy, created by the property owners within the drainage, is an organization formed to protect the unique ecological values of Deer Creek. The Deer Creek watershed property owners have owned, lived, and cared for the land for generations and will continue their responsible stewardship for future generations.

Watershed groups such as ours provide a forum for all stakeholders to become involved, to share ideas and to provide input throughout the planning and implementation process for land use decisions. This process will help build a common information base, keep communication channels open and establish trust and credibility among those wishing to protect and enhance the watershed. This consensus approach will facilitate conflict resolution while creating a positive direction for success.

The Watershed Conservancy is aware of their stewardship responsibilities regarding the preservation of Deer Creek and the valuable fish and wildlife resources within the drainage. This recognition includes the knowledge that Deer Creek is one of only four streams remaining in California's Central Valley supporting populations of Spring-run Chinook Salmon. The property owners will continue their responsible stewardship practices of living in harmony with the land. Their care and concern for the land is apparent by the existing pristine nature of the watershed.

Successful watershed conservancies are now in place on Deer, Mill, and Butte creeks, and additional conservancies are being formed on Clear, Battle and Big Chico creeks. Each conservancy is unique in its approach to watershed issues, but without exception, all have contributed substantially to efforts directed at protecting and restoring spring-run chinook salmon habitat.

Spring-run Chinook Salmon Workgroup. The Spring-run Chinook Salmon Workgroup was formed in 1992 to develop a coalition of individuals, groups, and organizations to achieve a grassroots restoration of spring-run chinook salmon. As intended when initially formed, it continues to be a broad amalgam of groups and individuals, all with a common goal of protecting and restoring spring-run chinook salmon.

The Workgroup, which operates by consensus, is facilitated by the University of California at Davis Sea Grant Extension Program, under a grant funded by the Commercial Salmon Stamp Account and administered by the Department. The Workgroup meets on a monthly basis, and has involved over 300 individuals representing private landowners, agencies, agriculture, cities and counties, environmental groups, timber industry, and commercial and sport fishing groups. The Workgroup's fundamental tenet is inclusion and cooperation, a basis which has effectively brought together the diverse stakeholders and constituencies.

The Workgroup has been extremely effective as a forum for communicating complex issues related to protecting and restoring spring-run chinook. The activities of the Workgroup, and its individual members, have very effectively facilitated implementation of many of the actions of both the state and federal restoration plans.

Ecosystem Management. Healthy, productive ecosystems are essential for salmon and steelhead populations, as well as for all other aquatic organisms. The Department must meet the legal and environmental challenges of ecosystem management to attain the goal of providing productive aquatic habitats, healthy and genetically diverse wild stocks, and adequate opportunities for California's recreational and commercial fishers. At its core, ecosystem management must address the identification and maintenance of broad ecosystem functions such as the geofluvial processes associated with gravel transport, erosion, and gravel recruitment, maintenance of healthy riparian corridors and shaded riverine aquatic habitats, emulation of annual hydrologic cycles, and maintenance of tidally influenced freshwater and brackish shallow water habitats. Spring-run chinook salmon are an essential element of the diverse aquatic communities that depend on Central Valley habitat, and ecosystem health is key to the health of this important run of chinook salmon.

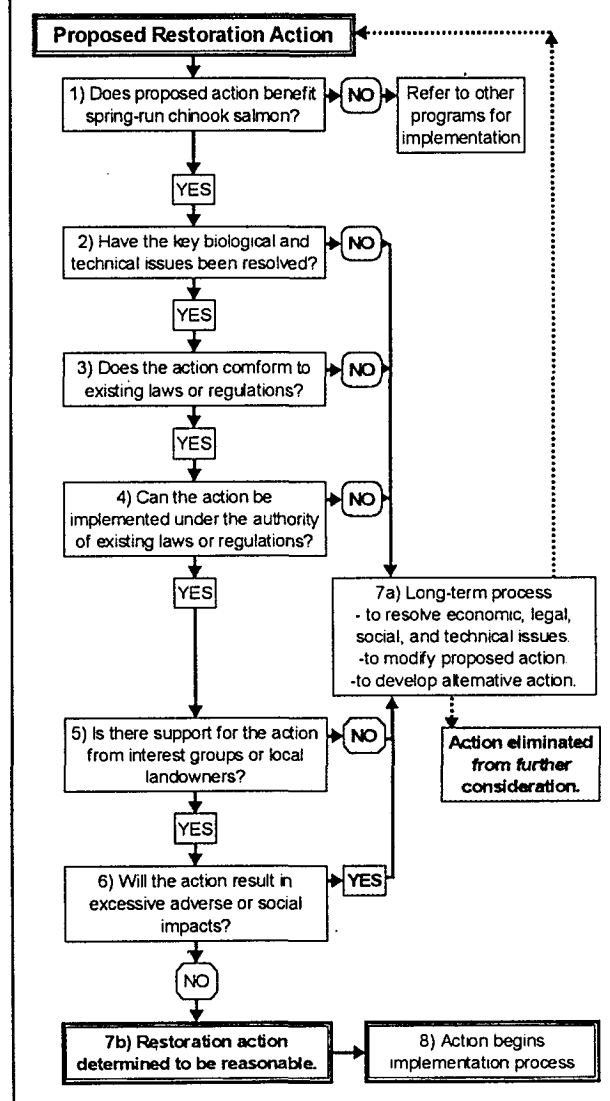
Reasonableness of Actions and Assurances. Contemporary salmon management and restoration programs need to be sensitive and responsive to the needs of our partners, stakeholders, interest groups, and other local, State, and Federal agencies. One of the common themes is the "reasonableness" of proposed restoration actions. The following discussion of reasonableness is modified from the USFWS's Draft Anadromous Fisheries Restoration Plan (USFWS 1995). The discussion lists a variety of concerns and factors which help to determine whether a proposed restoration action is reasonable.

The phrase "reasonable" is interpreted to mean an action that will not result in unreasonable cost or impact. In addition, what is reasonable depends upon the magnitude of benefit, the certainty that an action will achieve the projected benefit, and the authority established by existing laws and regulations.

The USFWS report describes a process and presents proposed evaluation criteria to be used to identify reasonable restoration actions (Figure 2). This will help potential partners initially identify actions that can be implemented to protect and restore spring-run chinook salmon. This process is not meant to replace NEPA or CEQA processes nor to circumvent existing laws and regulations for those actions to which they apply. Many actions initially considered reasonable by criteria in Figure 2 will be subject to NEPA, CEQA, or other processes. Figure 2 displays the multi-step process used to identify reasonable restoration actions. Although this process was developed to evaluate projects under the CVPIA AFRP, it is equally applicable to projects for the benefit of spring-run chinook salmon. Each of the steps is explained below:

- 1) Proposed actions must contribute to improving the natural production of spring-run chinook salmon.
- 2) Review of scientific and technical information regarding spring-run chinook salmon should be separate from consideration of economic and social impacts. Spring-run chinook salmon restoration and management participants should develop and adopt objective criteria that can be used to determine whether the existing information is adequate to proceed with further evaluation and implementation.
- 3) Reasonable actions to protect and restore spring-run chinook must comply with existing laws and regulations.
- 4) Restoration actions that are implementable under the authority of existing environmental laws will be considered reasonable. Existing laws were enacted by elected representatives and should reflect what society as a whole believes is reasonable. Existing regulations are assumed to have been developed with the benefit of public review and comment. Within the constraints of a specific law or regulation, it may still be necessary to exercise discretionary flexibility to ensure that actions are implemented in a reasonable manner. Actions that cannot be implemented under the authority of existing laws or regulations will require partners willing to implement the action.
- 5) Actions to protect and restore spring-run chinook that are supported or not strongly opposed by local landowners, interest groups, or the public at large will be considered reasonable. Lack of strong opposition probably indicates adverse impacts will be minimal. Opposition will be gaged through public meetings, letters received, and through NEPA or CEQA public involvement processes.

FIGURE 2. Process and Criteria to Identify Reasonable Actions to Protect and Restore Spring-run Chinook Salmon (see explanation in text, adapted from the USFWS, 1995).



- 6) Actions to protect and restore spring-run chinook salmon that do not result in excessive economic or social impacts will be considered reasonable, especially if those actions are supported by the partners most directly affected by the action.
- 7a) Proposed actions to protect and restore spring-run chinook salmon that are deemed "unreasonable" will be dropped from further consideration if alternative or modified actions cannot be identified or if economic, social, and technical issues cannot be resolved. In some cases, actions may become reasonable as a result of changing social and economic factors. Alternate or revised actions will be subjected to the same reasonableness screening process as the original actions.
- 7b) Actions that are found to be reasonable will be proposed for implementation through the CVPIA, Four Pumps Agreement, Tracy Agreement, Category III, and other potential funding sources.
- 8) Actions to protect and restore spring-run chinook identified as reasonable will be prioritized and implemented, contingent upon available funding and other resources.

The Department is the public trustee for the fish and wildlife resources of the State, and as such, has been vested with a variety of tools to assist in resource protection. In selecting reasonable actions, the Department's preference is to work collaboratively to select the most appropriate action. In some instances, the selected action may not be the most popular as the Department may base its recommendation for restoration on Public Trust requirements or other legal authorities such as those contained in the Fish and Game Code.

In recommending and developing measures to protect and restore spring-run chinook salmon, the Department is making a recommendation that the actions are deemed necessary and prudent. Our partners place trust in us that the actions, once implemented, will have a certain duration (shelf-life). In this process, the Department must be willing to formally provide assurances to our partners that we will not unduly change future requirements or expectation for existing and completed projects without also developing suitable compensation measures. These assurances are particularly needed for the unscreened diversion program. Although these assurances have not been developed, there should be a strategic assurance that addresses the broad concept, while finer detailed assurances must be developed on a site-specific basis.

PRIORITY OF ACTIONS

The activities proposed in each stream action plan fall into three general categories: habitat restoration, administrative actions, and evaluation studies. Habitat restoration actions are defined as those activities involving direct manipulation and modification of habitat or physical instream structures through the use of construction tools or heavy equipment. Administrative activities include negotiating streamflow agreements; enforcing existing laws and regulations; coordinating water management operations in tributaries, main stem rivers, and in the Delta; and participating in legal or administrative proceedings to obtain improved water quality or increased streamflow. Evaluation studies include long- and short-term efforts to collect data needed to develop and implement additional restoration actions.

Criteria to prioritize reasonable actions

Because resources are not sufficient to implement all reasonable actions simultaneously, an attempt will be made to implement high-priority items first. Monitoring will provide information to help in reevaluating priority for remaining actions. However, the implementation schedule should be flexible to take advantage of unique opportunities, even if it results in implementing actions that are not the highest priority.

Prioritization criteria primarily include biological considerations. All recommended actions are ranked according to a rating system (Table 3).

TABLE 3. Criteria Used for Developing Priority Ratings for Recommended Spring-run Chinook Salmon Restoration Actions.

Priority	Criteria
A	Actions to improve spring-run chinook salmon habitat having significant long-term benefits <u>or</u> evaluations needed prior to implementing restoration or administrative actions.
B	Actions to improve spring-run chinook salmon habitat having moderate long-term or significant short-term benefits <u>or</u> evaluations needed after completing restoration or administrative actions.
C	Actions to improve spring-run chinook salmon habitat resulting in incremental improvements to the habitat for these species at a level less than for priority B.

The following is a listing of habitat restoration actions designed to protect and restore spring-run chinook salmon throughout the important habitat areas within the Central Valley. These actions are derived from the two source documents listed earlier and include a few newly developed recommendations. The actions are not listed in any priority. Generally, habitat actions are followed by administrative actions and then by evaluation actions. Some actions include combinations of the above.

Priorities

SACRAMENTO RIVER

The Sacramento River (Figure 1, page 4) is the largest river system in California and yields 35% of the State's water supply. The chinook salmon populations of the Sacramento River provide most of the State's sport and commercial catch, and supports one of the largest contiguous riverine and wetland ecosystems in the Central Valley. Most of the Sacramento River flow is controlled by Shasta Dam which stores up to 4.5 million AF. River flow is augmented in an average year by transferring up to one million AF of Trinity River water through a tunnel to Keswick Reservoir. The USBR operates the Shasta-Trinity Division of the CVP. This division includes Shasta, Keswick, Trinity, Lewiston, Whiskeytown, and the Spring Creek Debris dams, Red Bluff Diversion Dam, and the Tehama-Colusa and Corning canals. The Sacramento River has historically supported four races of chinook salmon, including spring-run chinook. Recent evidence indicates that Sacramento River spring-run chinook have significantly hybridized with fall-run chinook. The following actions reflect the importance of the Sacramento River as it constitutes a significant portion of the migration habitat for all populations of spring-run chinook salmon.

SACRAMENTO RIVER - Actions to Protect and Recover Spring-run Chinook Salmon

Priority	Action
C	<p><i>Install and operate permanent structural temperature control devices at Shasta and Whiskeytown dams and develop and implement modifications in Central Valley Project operations as needed to assist in the Secretary of the Interior's efforts to control water temperatures in the upper Sacramento River.</i></p> <p>Type: Habitat Restoration Cost: Estimated \$105,000,000, requires state cost share Status: Under construction, will have minimal benefits to spring-run chinook. Partner: USFWS, USBR Source: CDFG 1993, USFWS 1995</p>
C	<p><i>Develop and implement permanent measures to minimize fish passage problems for adult and juvenile anadromous fish at the RBDD.</i></p> <p>Type: Habitat Restoration Cost: Estimated \$52,000,000, requires state cost share Status: Under evaluation, alternative methods to deliver water to the Tehama-Colusa Canal being examined, important to allow spring-run chinook access to Battle and Clear creeks. Partner: USBR, USFWS, CDFG, NMFS, TCCA Source: CDFG 1993</p>
A	<p><i>Resolve entrainment problems at the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant.</i></p> <p>Type: Habitat Restoration Cost: Estimated \$45-60,000,000, requires state cost share Status: Alternatives under evaluation, interim flat plate screen in place. Partner: CDFG, USBR, GCID, NMFS Source: CDFG 1993</p>

Special Report to the Fish and Game Commission

Priority

Action

- A *Control effluent from Iron Mt. Mine Superfund site until Basin Plan objectives are met.***
Type: Habitat Restoration
Cost: \$300,000,000
Status: In litigation and being implemented.
Partner: EPA, Stouffer Management Company, CDFG, SWRCB, NMFS, USFWS
Source: CDFG 1993
- A *Establish and maintain a Sacramento River meander belt and limit future bank protection to protect instream and riparian habitat.***
Type: Habitat Restoration
Cost: No Estimate
Status: Addressed by Upper Sacramento River Riparian Habitat Committee .
Partner: CDWR, Multi-Agencies, Counties, Local Landowners
Source: CDFG 1993
- C *Construct an effective escape channel in the west corner of the Keswick Dam stilling basin to protect salmon and steelhead.***
Type: Habitat Restoration
Cost: \$750,000
Status: Completed, minimal value for spring-run chinook.
Partner: USBR
Source: CDFG 1993
- A *Remove Sacramento River bank rip-rap and restore riparian wetland and anadromous fish habitat.***
Type: Habitat Restoration
Cost: No estimate
Status: Addressed by Upper Sacramento River Riparian Habitat Committee.
Partner: DWR, Multi-Agencies, Counties, Local Landowners
Source: CDFG 1993
- A *Continue acquisition of land and conservation easements to protect the riparian corridor.***
Type: Habitat Restoration
Cost: No estimate
Status: Addressed by Upper Sacramento River Riparian Habitat Committee.
Partner: CDWR, Multi-Agencies, Counties, Local Landowners
Source: CDFG 1993
- A *Continue planting riparian vegetation.***
Type: Habitat Restoration
Cost: No estimate
Status: Addressed by Upper Sacramento River Riparian Habitat Committee.
Partner: DWR, Multi-Agencies, Counties, Local Landowners
Source: CDFG 1993
- C *Correct fish passage and flow fluctuation problems at Anderson-Cottonwood Irrigation District's diversion dam.***
Type: Habitat Restoration
Cost: No estimate
Status: Operational agreements being developed, new lightweight flashboards developed and tested, catwalk to be constructed, requires state cost share, minimal benefit for spring-run chinook salmon.
Partner: CDFG, Anderson-Cottonwood Irrigation District
Source: CDFG 1993

Special Report to the Fish and Game Commission

Priority

Action

A *Screen the larger diversions on the Sacramento River.*

Type:	Habitat Restoration	
Cost:	No estimate,, requires state cost share	
Status:	Reclamation District 108	Planning phase
	Reclamation District 1004	Under evaluation
	Wilson-Newhall Ranch	Under evaluation
	Maxwell Irrigation District	Completed 1994
	Canell-1000 Acre Ranch	Completed 1995
	Provident Irrigation District	Action deferred
	Princeton-Cordua Irrigation Dist.	Action deferred
	Sutter-Mutual Irrigation District	Action deferred
	Pelgar-Mutual Water Agency	Completed 1994
	Remaining diversions	Under evaluation, diversion inventory underway and complete up to Hamilton City. Hamilton City to Red Bluff Diversion Dam is scheduled to be completed during 1996.

Partner: CDFG, USBR, USFWS, Diversers
Source: CDFG 1993

C *Manage agricultural return flows from Colusa Drain to control water temperatures in the Sacramento River, and install barriers to upstream migration.*

Type: Habitat Restoration
Cost: No estimate
Status: No action, minimal benefits for spring-run chinook salmon.
Partner: CDFG, CDWR
Source: CDFG 1993

A *Meet flow standards and objectives and diversion limits set forth in all laws and judicial decisions that apply to CVP facilities.*

Type: Administrative
Cost: No estimate
Status: Progress being made through CVPIA.
Partner: USBR
Source: CDFG 1993

A *Implement Basin Plan objectives for all water quality parameters.*

Type: Administrative
Cost: No estimate
Status: No action.
Partner: RWQCB
Source: CDFG 1993

A *Develop and implement a mechanism for real-time water projects operations coordination between the CVP and SWP.*

Type: Administrative
Cost: No estimate
Status: IEP real time monitoring in place, CALFED Ops Group coordinates operations when necessary.
Partner: USBR, CDWR
Source: CDFG 1993

Sacramento River

Priority

Action

- A** *Reevaluate carryover storage and operational criteria and implement a river flow regulation plan that balances carryover storage needs with instream flow needs based on runoff and storage conditions including the following minimum recommended flows at Keswick and Red Bluff Diversion Dams.*

Recommended minimum Sacramento River flows (cfs) at Keswick Dam for October 1 to April 30 based on October 1 carryover storage in Shasta Reservoir (maf) and critically dry runoff conditions (driest decile runoff of 2.5 maf) to produce a target April 30 Shasta Reservoir storage of 3.0-3.2 maf for temperature control.

(These recommendations may require adjustment to accommodate expanding need to provide water for rice straw decomposition in the Sacramento Valley in the fall.)

Carryover storage	Keswick release (cfs)
1.9 to 2.1	3,250
2.2	3,500
2.3	3,750
2.4	4,000
2.5	4,250
2.6	4,500
2.7	4,750
2.8	5,000
2.9	5,250
3	5,500

Type: Administrative

Cost: No estimate

Status: Environmental review underway, flow objectives used in interim operations planning.

Partner: USBR

Source: USFWS 1995

- A** *Seek general plan amendments to establish protection zones for riparian vegetation.*

Type: Administrative

Cost: No estimate

Status: Addressed by Upper Sacramento River Riparian Habitat Committee.

Partner: CDWR, Multi-agencies, Counties, Local landowners

Source: CDFG 1993

- C** *Develop implement, and evaluate a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of CVP dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the Sacramento River from Keswick Dam to RBDD.*

Type: Habitat restoration, Administrative, Evaluation

Cost: No estimate, requires state cost share

Status: Keswick spawning gravel project complete 1995. Long-term replenishment program needs to be developed. USFWS conducting limited evaluations of replenishment projects. Minimal benefits for spring-run chinook.

Partner: USBR, CDWR, CDFG, USACOE

Source: CDFG 1993

Special Report to the Fish and Game Commission

Priority

Action

A Evaluate the performance of all structural remedies implemented to protect and restore anadromous fish.

Type: Evaluation

Cost: No estimate

Status: Ongoing, evaluations done on a site-by-site basis as projects are implemented.

Partner: USBR, CDFG, USFWS

Source: CDFG 1993

A Complete the Sacramento River instream flow study.

Type: Evaluation

Cost: \$200,000

Status: Fish habitat/flow relationship work continues by CDFG and USFWS under CVPIA.

Partner: CDWR, CDFG, USFWS

Source: CDFG 1993

A Monitor metal, dioxin, and nutrient contaminants.

Type: Evaluation

Cost: \$300,000

Status: In progress.

Partner: EPA, CDFG, Simpson Paper Company

Source: CDFG 1993

C Evaluate the effectiveness of spring pulse flows on the survival of juvenile anadromous fish.

Type: Evaluation

Cost: No estimate

Status: No action.

Partner: USFWS, CDFG, USBR

Source: CDFG 1993

A Develop predictive models for hydrology, temperature, fish populations, fish harvest, water development, and wetlands.

Type: Evaluation

Cost: No estimate

Status: Temperature model under development (\$200,000), SALMOD salmon model under review by National Biological Survey.

Partner: CDFG, NBS, CDWR, USBR, USFWS, University of California at Davis

Source: CDFG 1993

B Evaluate the contribution of small Sacramento River tributaries as rearing areas for juvenile winter-, fall-, spring-, late-fall-run chinook salmon and steelhead

Type: Evaluation

Cost: No estimate

Status: Monitoring underway by California State University, Chico.

Partner: CDFG, USFWS, NMFS, CSUC

Source: CDFG 1993

ANTELOPE CREEK

Antelope Creek (Figure 3, page 23) originates in the Lassen National Forest at an elevation of about 6,800 feet. The drainage encompasses an area of approximately 123 square miles with an average stream discharge of 107,200 AF per year. Habitat for salmon in Antelope Creek above the valley floor is of good quality. Water diversions and a braided channel near the canyon mouth often create problems for fish passage during April through October.

Antelope Creek is closed to all fishing from the Sacramento River to the gauging station at the canyon mouth. Above the canyon mouth to the confluence with the North Fork, fishing is open from the last Saturday in April through November 15, with catch and release for trout and salmon.

The Department has reported that Antelope Creek could support up to 2,000 spring-run chinook salmon spawners, although recent evidence seems to suggest a potential for less than 500 fish. However, restoration actions need to be achieved for this to result. Two diverters, the Edwards Ranch and the Los Molinos Water Company (LMMWC), have water rights for 50 and 70 cfs respectively. Natural flows are often less than the combined rights of the two diverters, resulting in a total dewatering of the creek below the canyon mouth during critical periods for salmon. The average annual natural flow for the period 1940-1980, April through October, was 92 cfs.

Flows in Antelope Creek at the valley floor often split into four channels. The result of this split during the spring is often insufficient water to support passage for adult and juvenile migration. No clearly defined channel has been identified, although human intervention (water diversions) may partially be the cause of the split.

ANTELOPE CREEK - Actions to Protect and Recover Spring-run Chinook Salmon

Priority

Action

B Evaluate existing spring-run chinook salmon and steelhead holding, spawning, and rearing habitat to identify opportunities for habitat restoration.

Type: Evaluation

Cost: No estimate

Status: Limited evaluation in progress, USFWS conducted habitat typing in 1990s.

Partner: CDFG

Source: CDFG 1993

B Conduct a fish passage survey in the lower creek.

Type: Evaluation

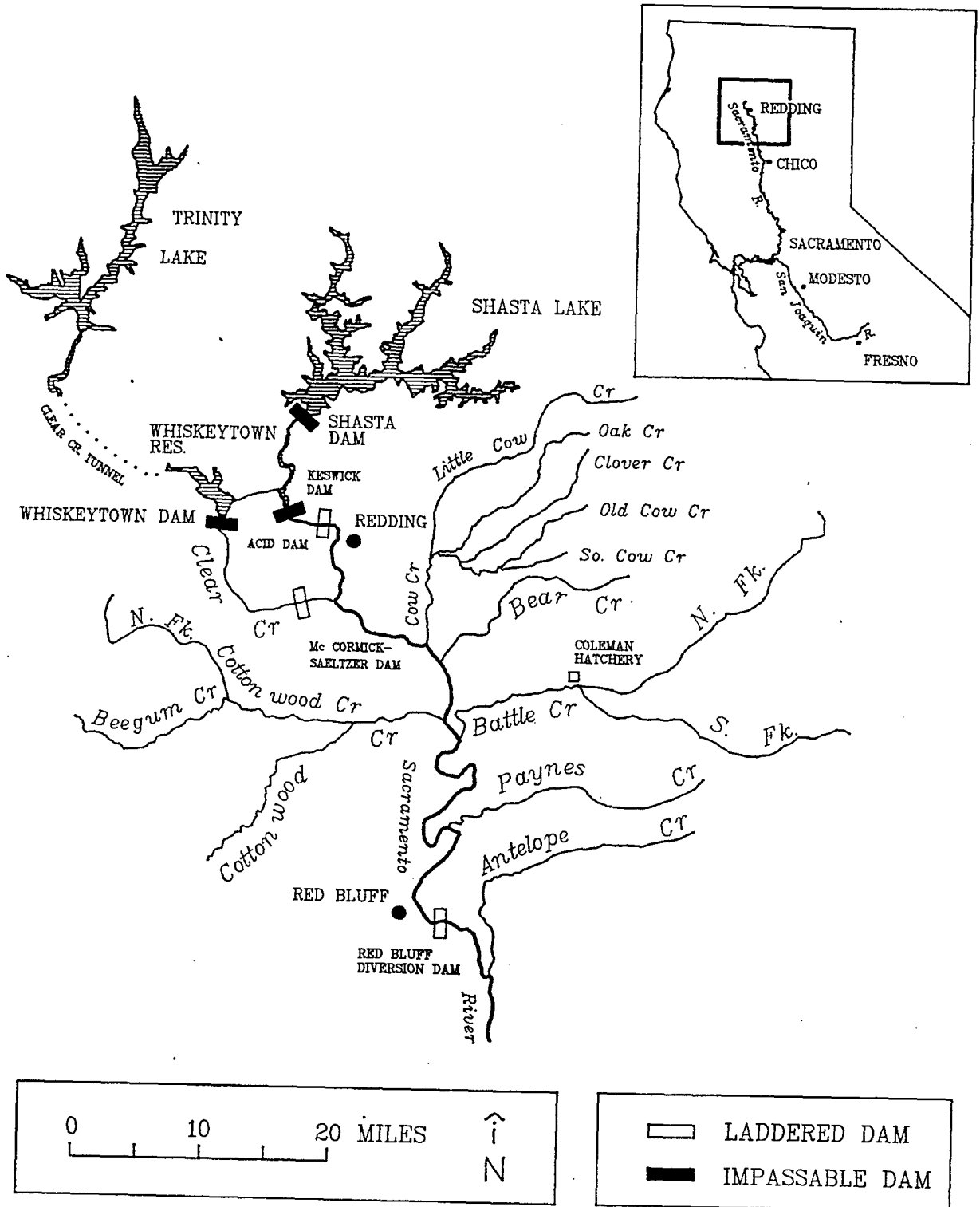
Cost: \$15,000

Status: No action.

Partner: CDFG, local landowners

Source: CDFG 1993

FIGURE 3. Map Depicting the Locations of Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek.



Special Report to the Fish and Game Commission

Priority

Action

- B *Reestablish the abandoned USGS gauging station upstream of the existing agricultural diversion dam.***
Type: Evaluation
Cost: \$25,000
Status: No action.
Partner: CDWR, USGS
Source: CDFG 1993
- A *Conduct annual spring-run chinook salmon snorkel surveys.***
Type: Evaluation
Cost: \$10,000
Status: Limited surveys conducted annually.
Partner: CDFG
Source: CDFG 1993
- C *Continue to install and monitor thermographs in the headwaters to record summer water temperatures in spring-run chinook salmon holding area.***
Type: Evaluation
Cost: \$5,000
Status: In progress.
Partner: CDFG
Source: CDFG 1993
- C *Install and operate a thermograph and streamflow gauge near the mouth to determine flow-temperature relationships.***
Type: Evaluation
Cost: No estimate
Status: No action.
Partner: CDFG, CDWR
Source: CDFG 1993
- C *Evaluate opportunities to acquire water for upstream and downstream fish passage.***
Type: Evaluation
Cost: No estimate
Status: No action.
Partner: CDFG, CDWR, Local landowners
Source: CDFG 1993 (as modified 1996)
- C *Evaluate the creation of a more defined stream channel to facilitate fish passage by minimizing water infiltration into the streambed and maintaining flows to the Sacramento River.***
Type: Evaluation
Cost: No estimate
Status: No action.
Partner: CDFG, CDWR, Local landowners
Source: CDFG 1993
-

BATTLE CREEK

Battle Creek (Figure 3, page 23) drains the western flank of Mt. Lassen and enters the Sacramento River at river mile 271 approximately five miles southeast of the Shasta County town of Cottonwood. It consists of two main branches, the North Fork and the South Fork, which join 16.6 miles above the mouth and flow into the Sacramento Valley from the east, draining a watershed of approximately 360 square miles. Although there are boulder-laden areas which can impede migration in the Eagle Canyon section of the North Fork, all diversion dams on Battle Creek have fish ladders (Macumber Dam and North Battle Creek Reservoir Dam are above barrier falls). Total annual yield of water from the drainage averages 340,000 acre-feet.

Prior to development Battle Creek was one of the most important chinook salmon spawning streams in the Sacramento Valley. The *California Fish and Wildlife Plan* (California Department of Fish and Game, 1965) estimated spawner abundance in Battle Creek at 21,000 fall-run, 1,000 winter-run, 1,000 spring-run and 5,300 steelhead. The blockage of chinook salmon migration at Coleman National Fish Hatchery (CNFH) and the effect of low flows caused by Pacific Gas and Electric's (PG&E) hydropower operations have combined to eliminate most salmon spawning above the hatchery.

CNFH, located approximately six miles upstream from the mouth of Battle Creek, is operated by the USFWS. CNFH was constructed by the USBR to provide partial mitigation for the construction of Shasta and Keswick dams and produces fall-run and late-fall-run chinook salmon and steelhead trout. Small numbers of winter-run chinook salmon, a State and federally listed endangered species, are also propagated at the hatchery.

BATTLE CREEK - Actions to Protect and Recover Spring-run Chinook Salmon

<i>Priority</i>	<i>Action</i>
A	<i>In the absence of a water exchange program, install fish screens on the agricultural diversion</i> Type: Habitat Restoration Cost: \$110,000 Status: No action. Partner: CDFG, PG&E, Local Diverters Source: CDFG 1993
A	<i>Improve fish passage in Eagle Canyon.</i> Type: Habitat Restoration Cost: \$5,000 Status: No action. Partner: CDFG, PG&E Source: CDFG 1993

Special Report to the Fish and Game Commission

Priority

Action

- A *Screen all unscreened hydropower diversions.***
Type: Habitat Restoration
Cost: \$900,000
Status: No action.
Partner: CDFG, PG&E
Source: CDFG 1993
- C *Restore spawning gravel in the North Fork.***
Type: Habitat Restoration
Cost: \$50,000
Status: Partially implemented, to be completed after CNFH disease concerns are addressed.
Partner: CDFG, PG&E
Source: CDFG 1993
- A *Through the FERC, water rights process, and direct agreements, increase releases from PG&E power plant diversions to provide for anadromous fish.***
Type: Administrative
Cost: Total cost unknown
Status: Category III funding (\$1,000,000) provided to acquire increase flows.
Partner: CDFG, FERC, SWRCB, PG&E, USFWS
Source: CDFG 1993
- A *Prepare and implement a comprehensive plan to restore Battle Creek for winter- and spring-run chinook salmon and steelhead.***
Type: Administrative
Cost: \$25,000
Status: In preparation by CDFG Region I.
Partner: CDFG, USFWS, PG&E
Source: CDFG 1993
- A *Continue to allow adult spring-run chinook salmon above the Coleman National Fish Hatchery weir if evaluations indicate adequate water temperatures for incubation and holding***

Type: Administrative
Cost: Unknown
Status: Implemented 1995, concerns regarding water temperatures must be resolved.
Partner: CDFG, USFWS
Source: USFWS 1995
- A *Complete an instream flow study.***
Type: Evaluation
Cost: \$200,000
Status: Completed.
Partner: CDFG, Payne and Associates
Source: CDFG 1993
- A *Evaluate effectiveness of fish ladders at PG&E diversions***
Type: Evaluation
Cost: No Estimate
Status: No Action.
Partner: CDFG
Source: USFWS 1995

Battle Creek

Special Report to the Fish and Game Commission

Priority

Action

A *Increase flows past PG&E hydropower diversions in two phases to provide adequate holding, spawning, and rearing habitat for anadromous salmonids.*

<u>Diversion</u>	<u>Months</u>	<u>Flow(cfs)</u>
Keswick Ditch	All year	30
North Battle		
Creek feeder	Sep-Nov	40
	Jan-Apr	40
	May-Aug	30
Eagle Canyon	May-Nov	30
	Dec-Apr	50
Wildcat	May-Nov	30
	Dec-Apr	50
South	May-Nov	20
	Dec-Apr	30
Inskip	May-Nov	20
	Dec-Apr	40
Coleman	Sep-Apr	50
	May-Aug	30

Type: Administrative

Cost: Unknown

Status: Partially implemented 1995 and has benefits for steelhead and several races of chinook salmon.

Partner: CDFG, USFWS, PG&E, FERC

Source: USFWS 1995

A *Investigate developing a disease-free water supply for CNFH.*

Type: Evaluation

Cost: Varies depending on solution: ozone treatment plants are very expensive, while alternative conveyance facilities are moderately expensive.

Status: In Progress.

Partner: USFWS, USBR

Source: CDFG 1993

BIG CHICO CREEK

Big Chico Creek (Figure 4, page 29) originates on Colby Mountain and flows 45 miles to its confluence with the Sacramento River. The watershed ranges from about 121 feet in elevation at the mouth to 5700 ft. and drains approximately 72 sq. miles. Big Chico Creek is joined by Mud and Rock Creeks 0.75 miles above its confluence with the Sacramento River. The majority of Big Chico Creek is bordered by private land with smaller holdings by the U. S. Forest Service and Bureau of Land Management. It flows through Bidwell Park, the third largest municipal park in the U. S., downtown Chico and the California State University, Chico campus. Habitat in areas upstream of the Five-Mile Diversion is relatively pristine because of the rugged nature of the canyon. Summer (June - October) base flow in Big Chico Creek above the Five-Mile Diversion is typically 20 to 25 cfs.

Big Chico Creek has carved a deep canyon through the foothills. Upstream from Higgin's Hole (at stream mile 23) it has cut through hard metamorphic rock resulting in a narrow canyon with big boulders, bedrock potholes, and spectacular waterfalls. In unusual years when migration corresponds exactly with high flow, salmon might get through this canyon to the waterfall at Bear Lake, but for all practical purposes, Higgin's Hole is the upstream limit for anadromous fish. The size of the waterfalls and the scenic nature of the upstream canyon preclude construction of fishways.

Estimates of adult spring-run chinook salmon in Big Chico Creek during 1957 to 1974 ranged from 0 to 1000, averaging 217. Few estimates were made after 1974, but it was assumed that the population was virtually extinct. With its relatively pristine holding and rearing habitat, there is reason to believe that Big Chico Creek can support salmon populations substantially above numbers present in the 70s and 80s.

BIG CHICO CREEK - Actions to Protect and Recover Spring-run Chinook Salmon

Priority

Action

A Relocate the M&T diversion to the Sacramento River and install fish screens.

Type: Habitat Restoration

Cost: \$4,200,000

Status: In progress, completion 1997.

Partner: CDFG, USBR, USFWS, Category III, Ducks Unlimited, M&T Ranch, Parrott Ranch, City of Chico

Source: CDFG 1993

A Repair or rebuild the water control structures at Five Mile Dam and Lindo Channel following completion of the hydrologic study.

Type: Habitat Restoration

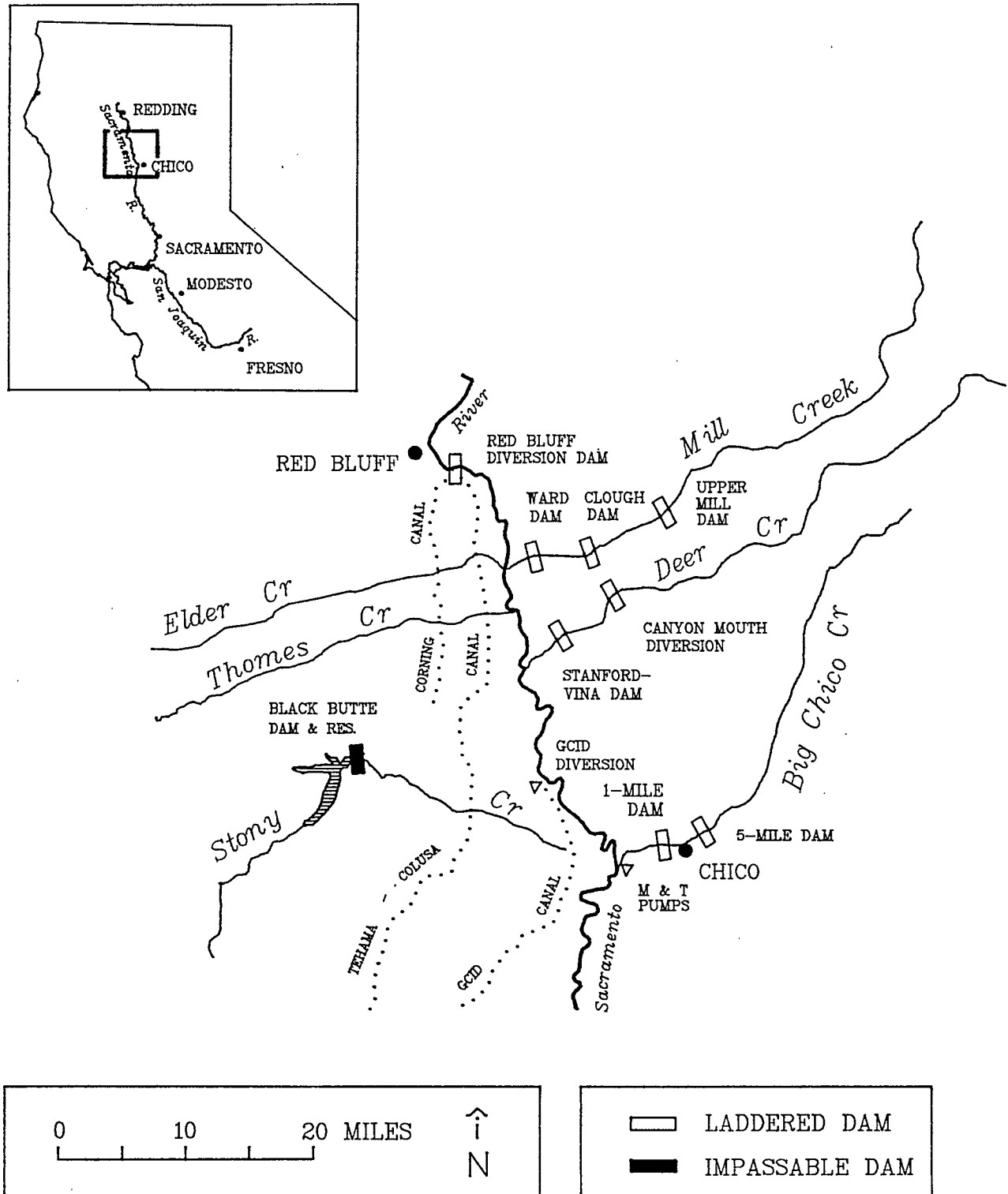
Cost: \$100,000

Status: No action.

Partner: CDFG, CDWR, City of Chico

Source: CDFG 1993

FIGURE 4. Map Depicting the Locations of Big Chico Creek, Deer Creek, and Mill Creek.



Special Report to the Fish and Game Commission

Priority

Action

A *Inspect and repair existing fish ladders.*

Type: Habitat Restoration
Cost: \$100,000
Status: In progress.
Partner: CDFG, City of Chico
Source: CDFG 1993

A *Prepare a watershed management and restoration plan.*

Type: Administrative
Cost: No estimate
Status: In progress by City of Chico and CDWR.
Partner: CDWR, City of Chico, CDFG
Source: CDFG 1993

B *Implement waste discharge requirements for operation of the One Mile Recreation Area.*

Type: Administrative
Cost: Unknown
Status: In progress by City of Chico.
Partner: RWQCB, City of Chico, CDFG
Source: CDFG 1993

A *Protect spring-run chinook salmon summer holding pools by obtaining from willing sellers titles or conservation easements on lands adjacent to the pool.*

Type: Administrative
Cost: Unknown
Status: No action.
Partner: CDFG, USFWS USBR, Landowners
Source: USFWS 1995

B *Cooperate with local land owners to encourage revegetation of denuded stream reaches and establish a protected riparian strip*

Type: Administrative
Cost: Unknown
Status: No action.
Partner: CDFG, USFWS USBR, Landowners
Source: USFWS 1995

A *Change fishing regulations to provide greater protection for spring run salmon in Big Chico Creek.*

Type: Administrative
Cost: Unknown
Status: Implemented 1994, modified 1996.
Partner: CDFG, FGC
Source: California Sport Fishing Regulations

A *Increase enforcement of fishing regulations to provide greater protection for spring run in Big Chico Creek.*

Type: Administrative
Cost: \$90,000 provided for 1994-95.
Status: Implemented 1994-95
Partner: CDFG, CDWR
Source: Four Pumps Agreement

Big Chico Creek

Special Report to the Fish and Game Commission

Priority	Action
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- | | |
|----------|--|
| A | <i>Organize a local watershed conservancy.</i>
Type: Administrative
Cost: Unknown
Status: In progress .
Partner: Local Landowners
Source: Local Landowners |
| A | <i>Monitor salmon and steelhead passage</i>
Type: Evaluation
Cost: Estimated \$50,000
Status: Limited monitoring in progress .
Partner: CDWR, CDFG
Source: CDFG 1993 |
| A | <i>Reestablish the Upper Bidwell Park USGS gauge</i>
Type: Evaluation
Cost: Estimated \$25,000
Status: Being installed.
Partner: CDWR, City of Chico
Source: CDFG 1993 |
| A | <i>Complete a sediment transport and hydrologic study</i>
Type: Evaluation
Cost: Estimated \$100,000
Status: Partially in progress.
Partner: CDWR
Source: CDFG 1993 |
| A | <i>Install and monitor thermographs</i>
Type: Evaluation
Cost: Estimated \$10,000
Status: Installed and operating.
Partner: CDFG
Source: CDFG 1993 |
-

BUTTE CREEK

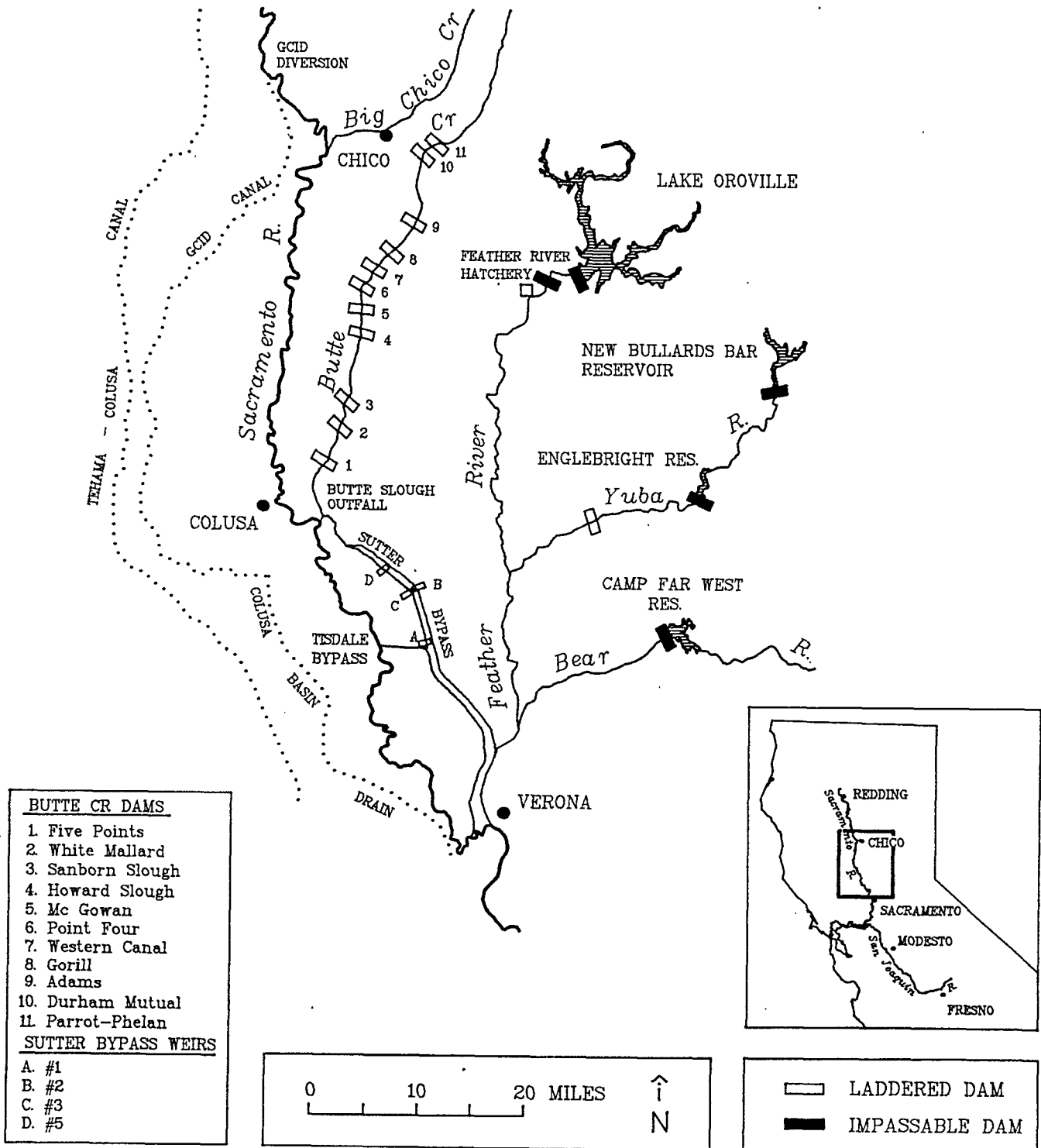
Butte Creek (Figure 5, page 33) originates in the Jonesville Basin, Lassen National Forest, at an elevation of about 6,500 feet. The watershed area comprises approximately 150 square miles. Several small tributaries converge in the Butte Meadows Basin, an area characterized by a series of wide meadows and repeating series of pools and riffles. Pine, cedar, and fir dominate the upper area while the predominant riparian vegetation within the meadow areas are alder and willows. Butte Creek transitions from the Butte Meadows area approximately 25 miles through a steep canyon to the point where it enters the valley floor near Chico. Numerous small tributaries and springs enter the creek in the canyon area. Deep shaded pools are interspersed throughout the upper section above Centerville while the area below is comprised of a shallower gradient and riparian canopy of alder, oak, and willow. Flows from the West Branch of the Feather River, diverted by Pacific Gas and Electric (PG&E) for power generation, enter Butte Creek via the Hendricks and Toadtown Canals at the Desabla Powerhouse. Two diversion dams built by PG&E in 1917 divert waters from Butte Creek for power generation. The lowermost, the Centerville Diversion Dam located immediately below the Desabla Powerhouse is generally considered to be the upper limit of anadromous fish migration.

The valley section of Butte Creek is divided by the Sutter Buttes, located in the center of Sacramento Valley. The upper portion is approximately 45 miles in length extending from Highway 99 near Chico to the point where Butte Creek first enters the Sacramento River at the Butte Slough Outfall Gates. Butte Creek in this reach is bordered almost entirely by agricultural lands, including several state and federal wildlife areas, and is generally contained by a series of levees. Historical record suggests that prior to levees being built along the Sacramento River, Butte Creek entered the River in the vicinity of the present Butte Slough Outfall gates.

Butte Creek flows are regulated into the Sacramento River by the Butte Slough Outfall Gates to accommodate both flood flows and agricultural needs in the Sutter Bypass area. The Sutter Bypass section of Butte Creek is approximately 40 miles in length. Butte Creek splits into two channels, known as the East and West Barrows, as it enters the Sutter Bypass near Highway 20. During normal flow periods, Butte Creek enters the Sacramento River via Sacramento Slough, immediately upstream of the mouth of the Feather River near Verona.

Butte Creek has historically supported a population of over 4,000 spring run chinook salmon. In recent years the population numbers have varied from less than 100 to more than 6,000 spring-run chinook salmon in 1995.

FIGURE 5. Map Depicting the Locations of Butte Creek, Feather River, and Yuba River.



BUTTE CREEK - Actions to Protect and Recover Spring-run Chinook Salmon

Priority

Action

A Acquire water rights from willing sellers.

Type: Habitat Restoration

Cost: Total cost unknown.

Status: Component of total need being acquired as part of M&T pump relocation, at estimated cost of \$2,000,000.

Partner: M&T Ranch, PIC, USFWS, CDFG

Source: CDFG 1993

A Identify and correct fish passage problems at diversions through dam removal or improvements to existing fish ladders.

Type: Habitat Restoration, Evaluation

Cost: Total cost unknown.

Status:

- Parrott-Phelan Dam completed 1995, cost \$400,000.
- Durham-Mutual Dam in progress, estimated cost \$400,000.
- Adams Dam under evaluation, no cost estimate
- Gorrill Dam under evaluation, no cost estimate.
- Western Canal Dam removal predesign and environmental evaluation in progress, total estimated cost \$8,000,000.
- McGowan Dam included in Western Canal project.
- McPherrin Dam included in Western Canal project.
- White Mallard Dam no action and no cost estimate.

Partner: Diverters, CDFG, USFWS, USBR, WCB, Category III

Source: CDFG 1993 (modified), USFWS 1995 (modified)

A Install fish screens on 11 agricultural diversions that range in capacity from 70 to 1,100 cfs.

Type: Habitat Restoration

Cost: Total cost unknown.

Status: Parrott-Phelan Dam completed 1995, cost \$120,000.

- Durham-Mutual Dam in progress, estimated cost \$200,000.
- Adams Dam under evaluation, no cost estimate.
- Gorrill Dam under evaluation, no cost estimate.
- Little Dry Creek pumps no action, no cost estimate.
- White Mallard Dam no action, no cost estimate.

Partner: Diverters, CDFG, USFWS, USBR, WCB, Category III

Source: CDFG 1993 (modified), USFWS 1995 (modified)

A Improve spawning and rearing habitat.

Type: Habitat Restoration

Cost: Estimated \$200,000

Status: No action.

Partner: CDFG, USFWS, USBR

Source: CDFG 1993

B Eliminate chinook salmon stranding at White Mallard Duck Club outfall.

Type: Habitat Restoration

Cost: No estimate

Status: No action.

Partner: CDFG, USFWS, USBR, White Mallard Duck Club

Source: USFWS 1995

Special Report to the Fish and Game Commission

Priority

Action

B *Rebuild and maintain existing culvert and riser at Drumheller Slough outfall*

Type: Habitat Restoration

Cost: No estimate

Status: No action.

Partner: CDFG, USFWS, USBR, Reclamation District 1004

Source: USFWS 1995

A *Prepare a salmon and steelhead management and habitat restoration plan.*

Type: Administrative

Cost: No estimate

Status: No action.

Partner: CDFG, Butte Creek Conservancy

Source: CDFG 1993

A *Seek amendments to existing water rights and power licenses to provide additional flow for salmon and steelhead.*

Type: Administrative

Cost: No estimate

Status: Partial implementation related to M&T pumping plant relocation at estimated cost of \$2,000,000.

Partner: CDFG, USFWS, FERC, SWRCB, USBR

Source: CDFG 1993

A *Maintain a minimum 40 cfs instream flow below Centerville Diversion Dam*

Type: Administrative

Cost: No estimate

Status: No action.

Partner: CDFG, USFWS, FERC, PG&E

Source: USFWS

B *Acquire water rights as part of the Western Canal Siphon Project.*

Type: Administrative

Cost: No estimate

Status: Under evaluation.

Partner: Western Canal Water District, CDFG, USBR

Source: USFWS 1995

A *Adjudicate water rights and provide water master service for the entire creek: enforce or initiate legal action on diverters who are violating water right allocations.*

Type: Administrative

Cost: No estimate

Status: No action.

Partner: CDWR, SWRCB

Source: USFWS 1995

B *Establish operational criteria at Sanborn Slough Bifurcation.*

Type: Administrative

Cost: No estimate

Status: No action.

Partner: DFG, CDWR, SWRCB

Source: USFWS 1995

Butte Creek

Special Report to the Fish and Game Commission

Priority

Action

B *Establish operational criteria at East and West Borrow pits.*

Type: Administrative
Cost: No estimate
Status: No action.
Partner: CDFG, CDWR, Reclamation District 70
Source: USFWS 1995

B *Establish operational criteria at Nelson Slough.*

Type: Administrative
Cost: No estimate
Status: No action.
Partner: CDWR, CDFG
Source: USFWS 1995

B *Increase enforcement of fishing regulations.*

Type: Administrative
Cost: \$90,000 provided in 1994-95.
Status: Implemented 1994-95, Four Pumps funding.
Partner: CDFG, CDWR
Source: USFWS 1995, CDWR Four Pumps

B *Develop a watershed management program.*

Type: Administrative
Cost: No estimate
Status: No action.
Partner: CDFG, Butte Creek Conservancy
Source: USFWS 1995

C *Develop and enforce land use plans that create buffer zones between the creek and urban development.*

Type: Administrative
Cost: No estimate
Status: No action.
Partner: CDFG, Counties, Butte Creek Conservancy
Source: USFWS 1995

A *Change fishing regulations to provide greater protection for spring run salmon in Butte Creek.*

Type: Administrative
Cost: Unknown
Status: Implemented 1994.
Partner: CDFG
Source: California Sport Fishing Regulations

A *Organize a local watershed conservancy.*

Type: Administrative
Cost: Unknown
Status: Organized 1995.
Partner: Local Landowners
Source: Butte Creek Conservancy

Butte Creek

Special Report to the Fish and Game Commission

Priority

Action

A Conduct water quality study.

Type: Evaluation
Cost: \$100,000
Status: Thermal monitoring ongoing .
Partner: CDFG, CDWR
Source: CDFG 1993

A Monitor fish passage.

Type: Evaluation
Cost: \$100,000
Status: In progress, emigration study being conducted by CDFG Region 2.
Partner: CDFG, USFWS
Source: CDFG 1993

A Conduct an instream flow study.

Type: Evaluation
Cost: Estimated \$150,000
Status: No action.
Partner: CDFG
Source: CDFG 1993

A Develop hydrologic model.

Type: Evaluation
Cost: No estimate
Status: No action.
Partner: CDFG, CDWR
Source: CDFG 1993

A Identify and correct fish passage problems at diversions in Butte Creek through dam removal or improvement to existing ladders.

Type: Evaluation
Cost: No estimate
Status: Develop and evaluate operational criteria and potential modifications to Butte Slough outfall.

- Evaluate alternatives or build a new high volume fish ladder at East-West diversion weir.
- Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #2.
- Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #1.
- Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #5.
- Evaluate alternatives to help fish passage including the installation of a high water fish ladder on Sutter Bypass Weir #2.
- Evaluate alternatives to help fish passage including the installation of a high water fish ladder on Sutter Bypass Weir #1.
- Evaluate alternatives to help fish passage including the installation of a high water fish ladder on Sutter Bypass Weir #5.
- Evaluate alternatives to help fish passage including the installation of a high water fish ladder on Sutter Bypass Weir #3.
- Evaluate enhancement of fish passage at natural barrier below Centerville Diversion Dam.
- Evaluate fish passage enhancement at PG&E diversion dams and other barriers above Centerville Diversion Dam.

Partner: CDFG, CDWR, USFWS, USBR, Diversers
Source: USFWS 1995

Butte Creek

Special Report to the Fish and Game Commission

Priority

Action

- A Evaluate alternatives to help fish passage including installation of screens at Sanborn Slough Bifurcation Structure.***
Type: Evaluation
Cost: No estimate
Status: No action.
Partner: CDFG
Source: USFWS 1995
- A Evaluate alternatives to help fish passage by including installation of fish screens within Sutter Bypass where necessary.***
Type: Evaluation
Cost: No estimate
Status: No action.
Partner: CDFG
Source: USFWS 1995
- A Evaluate potential to extend spring run salmon access above Centerville Diversion Dam.***
Type: Evaluation
Cost: \$15,000
Status: In progress .
Partner: USBR, Spring-run Workgroup, CSUC
Source: USBR, Spring-run Workgroup 1995
- A Monitor water temperatures in Butte Creek***
Type: Evaluation
Cost: \$25,000
Status: In progress.
Partner: USBR, Spring-run Workgroup, CDWR
Source: USBR, Spring-run Workgroup 1995
- A Develop genetic marker for racial identification***
Type: Evaluation
Cost: No estimate
Status: In progress.
Partner: CDFG, CDWR, University of California
Source: CDFG (new)
-

CLEAR CREEK

Clear Creek (Figure 3, page 23) is the first major tributary to the Sacramento River below Shasta Dam. The creek originates about 20 miles north of French Gulch at an elevation of over 5,000 feet. The length of the stream is about 50 miles and it flows into the Sacramento River seven miles below Redding. Whiskeytown Reservoir, formed by a 278-foot-high dam, inundates eight miles of the creek at a location 16.5 miles upstream of the Sacramento River.

Whiskeytown Dam impounds and conveys water from both the Clear Creek watershed, at an average volume of 260,000 acre-feet per year (USBR Inflow Data), and the Trinity River Diversion, at an average of 1,200,000 acre-feet per year (U.S. Geological Survey [USGS] Surface Water Records for Carr Powerhouse). All of this impounded water is conveyed to the Sacramento River via the Spring Creek tunnel except for the release to Clear Creek below the dam which only amounts to 42,000 acre-feet or three percent of the average total volume received by the dam. The amount of water currently released down Clear Creek is less than the driest natural runoff that ever occurred in the record.

Clear Creek supports runs of fall-run chinook, late fall-run chinook, steelhead and, historically, spring-run chinook. Initially, near the turn of the century, anadromous fish were blocked from the foothill spawning areas by Saeltzer Dam, however, several fish ladder installations were made in the mid-century that were partially effective, leaving the dam as a partial barrier. The foothill reach of the stream has habitat that is suitable for spring-run chinook and steelhead but lacks good access due to Saeltzer Dam. Projected goals for restoration that are judged to be attainable after the creek is restored are 4,000 to 7,000 fall-run, 2,000 late-fall, 500 to 1,000 spring-run chinook salmon and 500 to 1,000 steelhead.

CLEAR CREEK - Actions to Protect and Recover Spring-run Chinook Salmon

Priority	Action
A	<i>Negotiate and provide flows from Whiskeytown Dam to provide adequate spawning, incubation, rearing, and emigration habitat for salmon and steelhead.</i> Type: Habitat Restoration, Administrative Cost: No estimate Status: Temporarily implemented 1995, 150 cfs provided . Partner: USBR, CDFG Source: CDFG 1993
C	<i>Evaluate, restore, and monitor spawning gravel in Clear Creek above Saeltzer Dam.</i> Type: Habitat Restoration Cost: \$500,000 Status: No action, adequate gravel available for spring-run chinook spawning. Partner: CDFG Source: CDFG 1993

Special Report to the Fish and Game Commission

Priority

Action

- C *Purchase land adjacent to the stream above Saeltzer Dam to preserve remaining sources of spawning gravel.***
Type: Habitat Restoration
Cost: No estimate
Status: No action.
Partner: CDFG, Landowners
Source: CDFG 1993
- A *Prepare a multi-agency Comprehensive Resource Management Plan to address excessive erosion in the watershed.***
Type: Administrative
Cost: \$300,000
Status: In progress by Resource Conservation District.
Partner: Federal, State, Local Agencies
Source: CDFG 1993
- A *Conduct an instream flow study.***
Type: Evaluation
Cost: Estimated \$300,000
Status: CDWR and CDFG completed instream flow study in 1985. USBR planning new instream flow study through the CVPIA to reassess flows and develop new recommendations.
Partner: CDFG, USBR, USFWS, CDWR
Source: CDFG 1993
- A *Monitor and evaluate opportunities to improve adult salmon and steelhead passage at Saeltzer Dam.***
Type: Evaluation
Cost: Estimated \$10,000, requires state cost share
Status: Limited monitoring presently underway.
Partner: CDFG
Source: CDFG 1993
-

DEER CREEK

Deer Creek (Figure 4, page 29) is a major tributary to the Sacramento River originating upstream of Deer Creek Meadows from several small springs near Childs Meadows to the north and from the northern slopes of Butt Mountain to the south. Below its source on the slopes of these two mountain meadows, Deer Creek flows through many miles of rugged canyon cut deeply through an ancient lava flow. At higher elevation the terrain is forested with coniferous trees, in lower regions, the cover becomes a typical valley oak-grassland association. About 25 miles of the upper stream is paralleled by State Highway 32. The lower ten miles flows through the Sacramento Valley where most of the flow is diverted. In many years, diversions at three dams deplete all of the natural flow from mid-spring to fall. All of the diversion structures have fish ladders and screens. The creek enters the Sacramento River at RM 230, approximately 1.5 miles north of Woodson Bridge State Park. The watershed drains 200 square miles and is 60 miles in length.

Fall, late-fall, and spring-run chinook salmon use Deer Creek. Of all Sacramento Valley streams, Deer Creek is believed to have one of the greatest potentials for supporting spring-run chinook salmon. The creek is estimated to be able to support sustainable populations of 4,000 spring-run and 6,500 fall-run chinook salmon (CDFG 1993).

DEER CREEK - Actions to Protect and Recover Spring-run Chinook Salmon

Priority

Action

B Protect and maintain chinook salmon and steelhead habitat in upper Deer Creek.

Type: Habitat Restoration
Cost: No estimate
Status: In progress.
Partner: CDFG,USFWS, Local Landowners
Source: USFWS 1995

C Control cane (bamboo) at several sites in lower Deer Creek.

Type: Habitat Restoration
Cost: \$8,000
Status: Funding provided, removal program being developed.
Partner: Deer Creek Watershed Conservancy, USBR, Spring-run Workgroup
Source: USBR, Spring-run Workgroup

B Install livestock exclusion fencing along upper Deer Creek.

Type: Habitat Restoration
Cost: No estimate
Status: Installed 1994, and additional fencing in progress.
Partner: Local Landowners, Deer Creek Watershed Conservancy, CDFG
Source: CDFG

Special Report to the Fish and Game Commission

Priority

Action

B *Install livestock exclusion fencing along lower Deer Creek.*

Type: Habitat Restoration

Cost: \$22,000

Status: Scheduled for implementation 1996, primary benefit to fall-run chinook.

Partner: Local Landowners, Deer Creek Watershed Conservancy, USBR, Spring-run Workgroup

Source: USBR, Spring-run Workgroup

C *Increase enforcement of fishing regulations.*

Type: Administrative

Cost: \$90,000 provided in 1994-95

Status: Implemented 1994-95, Four Pumps funding.

Partner: CDFG,

Source: USFWS 1995, CDWR Four Pumps

A *Change fishing regulations to provide greater protection for spring-run salmon in Deer Creek.*

Type: Administrative

Cost: No estimate

Status: Implemented 1994, additional restrictions would require closing to all fishing.

Partner: CDFG, Fish and Game Commission

Source: California Sport Fishing Regulations

A *Organize a local watershed conservancy.*

Type: Administrative

Cost: Unknown

Status: Deer Creek Watershed Conservancy organized 1994.

Partner: Members and cooperators include: CDFG; CDF; SWRCB; University of California, Davis; BLM; USBR; USFS; USRCS, Collins Pine Company; Sierra Pacific Industries; Stanford Vina Irrigation District; Tehama Counts Cattlemen's Association, Tehama County Farm Bureau

Source: Deer Creek Watershed Conservancy

A *Develop watershed management plan.*

Type: Administrative

Cost: No estimate

Status: In preparation under a grant from EPA.

Partner: Deer Creek Watershed Conservancy, Los Molinos School District, EPA

Source: Deer Creek Watershed Conservancy

A *Through negotiations, obtain instream flows for salmon and steelhead in the lower reach.*

Type: Administrative

Cost: Estimated cost \$2,200,000

Status: Water exchange facilitated by Four Pumps Agreement, implementation 1996-97.

Partner: CDWR, Deer Creek Irrigation District, Stanford Vina Irrigation District, CDFG

Source: CDFG 1993

B *Negotiate long-term agreements and implement a program to maintain and restore riparian habitats along the lower reaches of Deer Creek.*

Type: Administrative, Habitat Restoration

Cost: No estimate

Status: No action.

Partner: CDFG, Local Landowners

Source: USFWS 1995

Deer Creek

Special Report to the Fish and Game Commission

Priority	Action
B	<i>Plan and coordinate required flood management activities with least damage to the fishery resources and riparian habitats of lower Deer Creek.</i> Type: Administrative Cost: No estimate Status: No action. Partner: CDWR, CDFG Source: USFWS 1995
A	<i>Initiate legislation to limit construction of additional dams on Deer Creek.</i> Type: Administrative Cost: No estimate Status: Implemented 1995, AB 1413. Partner: Deer Creek Watershed Conservancy Source: Deer Creek Watershed Conservancy
A	<i>Install an electronic fish counter on one of the diversion dams.</i> Type: Evaluation Cost: Estimated \$20,000 Status: Operated since 1994. Partner: CDFG Source: CDFG 1993
A	<i>Conduct an instream flow study in the lower stream reach.</i> Type: Evaluation Cost: Estimated \$50,000 Status: No action. Partner: CDFG Source: CDFG 1993
A	<i>Evaluate fish passage problems throughout the drainage.</i> Type: Evaluation Cost: Estimated \$25,000 Status: Partially completed, ongoing. Partner: CDFG Source: CDFG 1993
C	<i>Conduct a temperature modeling study in the stream reaches below existing diversions.</i> Type: Evaluation Cost: Estimated \$20,000 Status: No action. Partner: CDFG Source: CDFG 1993

FEATHER RIVER

The Feather River (Figure 5, page 44), with a drainage area of 3,607 square miles, is the largest tributary of the Sacramento River below Shasta Dam. Oroville Reservoir, the lowermost reservoir on the river and the upstream limit for anadromous fish, is the keystone of the State Water Project and operated by CDWR. Water is released from Oroville Dam through a multi-level outlet to provide appropriate water temperatures for the operation of Feather River Hatchery and to protect downstream fisheries.

Feather River flows between the Thermalito Diversion Dam and the Thermalito Afterbay Outlet are a constant 600 cfs. This section is often referred to as the "low-flow" river section. Water is released through a powerhouse, then through the Fish Barrier Dam to the Feather River Hatchery, and finally into the low-flow section of the Feather River. Feather River Hatchery is currently the only Central Valley egg source for spring run chinook salmon; however, serious concern exists regarding the genetic integrity of the Feather River Hatchery stock of spring-run chinook salmon.

FEATHER RIVER - Actions to Protect and Recover Spring-run Chinook Salmon

Priority	Action
A	Conduct a comprehensive genetic analysis of Feather River fall- and spring-run chinook stocks to determine purity or degree of introgression of each race.
	Type: Evaluation
	Cost: Estimated \$100,000
	Status: No action.
	Partner: CDFG, CDWR, NMFS, USFWS, University of California
	Source: CDFG (New 1996)

MILL CREEK

Mill Creek (Figure 4, page 29) originates on Mt. Lassen at an elevation of approximately 8,000 feet and descends to 200 feet at its confluence with the Sacramento River. The watershed drains 134 square miles and the stream is approximately 60 miles in length. The creek is confined within a steep-sided, relatively inaccessible canyon in the upper watershed. During the irrigation season three dams on the lower eight miles of the stream divert most of the natural flow, particularly during dry years. The majority of the creek is bordered by U.S. Forest Service land. Private land holdings exist only in the extreme headwaters and on the valley floor. The stream flows through the Ishi Wilderness Area and the Gray Davis Dry Creek Preserve, which is managed by The Nature Conservancy. Mill Creek spring-run chinook salmon are unique for spawning at an altitude in excess of 5,000 feet, the highest altitude known for salmon spawning in California.

Between 1947 and 1964 Mill Creek had an average spring-run population of nearly 2,000 adults. Presently, the Department believes that the upstream habitat could support about 5,000 adult spring-run chinook salmon.

MILL CREEK- Actions to Protect and Recover Spring-run Chinook Salmon

Priority	Action
B	Maintain and restore riparian habitat along the lower reaches of Mill Creek. Type: Habitat Restoration Cost: No estimate Status: No action. Partner: CDFG, USFWS, Local Landowners Source: USFWS 1995
A	Organize a local watershed conservancy. Type: Administrative Cost: Unknown Status: Mill Creek Conservancy organized 1995. Partner: Local Landowners Source: Mill Creek Conservancy
A	Develop watershed management plan. Type: Administrative Cost: No estimate Status: In preparation under a grant from the EPA. Partner: Mill Creek Conservancy, Los Molinos School District, EPA Source: Mill Creek Conservancy
A	Initiate legislation to limit construction of additional dams on Mill Creek. Type: Administrative Cost: No estimate Status: Implemented 1995, AB 1413. Partner: Mill Creek Conservancy Source: Mill Creek Conservancy

Special Report to the Fish and Game Commission

Priority

Action

- A** ***Continue to provide recommendations to the USFS for developing land use policies to protect spring-run chinook salmon habitat.***
Type: Administrative
Cost: No estimate
Status: In progress, extremely important as spring-run chinook in summer holding areas are vulnerable to humans and human-induced activities.
Partner: CDFG, USFS
Source: CDFG 1993
- A** ***Obtain increased flows to allow adult and juvenile salmon and steelhead unimpaired up- and downstream passage.***
Type: Administrative
Cost: No estimate
Status: Implemented 1994-95.
Partner: CDWR, CDFG, Local Diversers
Source: CDFG 1993
- A** ***Evaluate fish passage at Clough Dam and determine alternative structural remedies to allow salmon improved access to spawning areas.***
Type: Evaluation
Cost: No estimate
Status: In progress.
Partner: Landowner, Mill Creek Conservancy, Los Molinos Mutual Water Company, CDFG
Source: USFWS 1995
- A** ***Conduct a stream flow study.***
Type: Evaluation
Cost: Estimate \$25,000
Status: In progress.
Partner: Mill Creek Conservancy, USBR, Spring-run Workgroup, CDFG
Source: CDFG 1993
- A** ***Install a stage recorder to monitor flows.***
Type: Evaluation
Cost: Estimate \$20,000
Status: Installed 1994.
Partner: CDWR, CDFG
Source: CDFG 1993
- A** ***Investigate the flow-temperature relationship.***
Type: Evaluation
Cost: Estimate \$25,000
Status: No action.
Partner: CDFG
Source: CDFG 1993
- A** ***Investigate potential sediment sources in Mill Creek Watershed.***
Type: Evaluation
Cost: Estimate \$55,000
Status: In progress.
Partner: Mill Creek Conservancy, USBR, Spring-run Workgroup
Source: Mill Creek Conservancy, USBR, Spring-run Workgroup

Special Report to the Fish and Game Commission

Priority

Action

A **Develop GIS database for Mill Creek watershed.**

Type: Evaluation

Cost: No estimate

Status: In progress.

Partner: Mill Creek Conservancy, USBR, Spring-run Workgroup

Source: Mill Creek Conservancy, USBR, Spring-run Workgroup

YUBA RIVER

The Yuba River (Figure 5, page 33) watershed drains 1,339 square miles of the western slope of the Sierra Nevada Mountain Range, and includes portions of Sierra, Placer, Yuba, and Nevada Counties. Most of the water from Englebright Dam, the lowermost dam on the river and the upstream limit of anadromous fish, is released through the Narrows 1 and 2 powerhouses for hydroelectric power generation. The 0.7 miles of river downstream of the Narrows 1 and 2 powerhouses to the mouth of Deer Creek is characterized by steep rock walls, long deep pools and short rapids. The river canyon opens into a wide flood plain at the downstream end of the Narrows where large quantities of hydraulic mining debris remain from past gold mining operations. This 18.5 mile section is typified as open valley plain. The open valley plain continues 7.8 miles below Daguerre Point Dam to beyond the downstream terminus of the Yuba Goldfield. The remaining section of the lower Yuba extends approximately 3.5 miles to the confluence with the Feather River.

A small population spring-run chinook salmon occurred historically in the Yuba River. However, the run virtually disappeared by 1959, presumably due to diversion and hydraulic developments on the river. A remnant population persists and is maintained by fish produced in the river, salmon straying from the Feather River, and from infrequent stocking of hatchery-reared fish by the Department.

YUBA RIVER- Actions to Protect and Recover Spring-run Chinook Salmon

Priority

Action

A Install screen on Browns Valley Irrigation District diversion.

Type: Habitat Restoration
Cost: No estimate
Status: Proposal being developed.
Partner: CDFG, Browns Valley Irrigation District, SWRCB
Source: CDFG 1993

A Replace screens on South Yuba-Brophy and the Hallwood-Cordua diversions.

Type: Habitat Restoration
Cost: No estimate
Status: Proposal being developed for Hallwood-Cordua, no action on South Yuba Brophy.
Partner: CDFG, Diversers, USACOE, USFWS, SWRCB
Source: CDFG 1993

A Improve spawning and rearing habitat.

Type: Habitat Restoration
Cost: Estimated \$1,000,000
Status: Projects being developed.
Partner: CDFG, PG&E, USFWS, Yuba County Water Agency
Source: CDFG 1993

Special Report to the Fish and Game Commission

Priority

Action

B Protect and manage riparian habitat.

Type: Habitat Restoration
Cost: Estimated \$100,000 per year
Status: No action.
Partner: CDFG
Source: CDFG 1993

A Evaluate options to facilitate passage of spawning adult salmonids by maintaining appropriate flows through the fish ladder or by modifying the fish ladders at Daguerre Point Dam.

Type: Habitat Restoration, Evaluation
Cost: \$4,700,000 to include fish ladder, fish screen, and modification of face of dam
Status: Evaluation in progress: USACOE feasibility study.
Partner: CDFG, USACOE, USFWS, Yuba County Water Agency
Source: USFWS 1995

A Facilitate passage of juvenile salmonids by modifying face of Daguerre Point Dam.

Type: Habitat Restoration
Cost: \$4,700,000 to include fish ladder, fish screen, and modification of face of dam
Status: Evaluation in progress: USACOE feasibility study.
Partner: CDFG, USACOE, USFWS, Yuba County Water Agency
Source: USFWS 1995

A Ensure compliance with fish screening requirements in Fish and Game Code Section 6100.

Type: Administrative
Cost: No estimate
Status: No action.
Partner: CDFG
Source: CDFG 1993

A Require the following temperatures and streamflows to protect salmon and steelhead in the Lower Yuba River:

Maximum Temperature (°F)

<u>Period</u>	<u>@Daguerre</u>	<u>@Marysville</u>
Oct - Mar	56	57
April	60	60
May NR	60	
June	NR	65
Jul - Aug	65	NR
Sept NR	65	

Streamflow (cfs)

<u>Period</u>	<u>@Marysville</u>
Oct-Mar	700
April	1,000
May	2,000
June	1,500
Jul-Sept	450

Type: Administrative
Cost: No estimate
Status: Under consideration by State Water Resources Control Board.
Partner: SWRCB, CDFG
Source: CDFG 1993

Yuba River

Special Report to the Fish and Game Commission

Priority

Action

- A Develop a plan to increase rearing habitat for juvenile salmon and steelhead.***
Type: Administrative
Cost: No estimate
Status: No action.
Partner: CDFG
Source: CDFG 1993
- B Regulate gravel extraction to protect salmon and steelhead spawning areas.***
Type: Administrative
Cost: No estimate
Status: No action.
Partner: CDFG, Yuba County, State Lands Commission
Source: CDFG 1993
- A Purchase streambank conservation easements to improve salmonid habitat and instream cover.***
Type: Administrative
Cost: No estimate
Status: In progress by BLM through purchase of easements or fee title.
Partner: CDFG, Landowners, BLM, Western Aggregates
Source: USFWS 1995
- A Increase river patrols in areas where poaching is a concern.***
Type: Administrative
Cost: No estimate
Status: No action.
Partner: CDFG
Source: USFWS 1995
- A Operate reservoirs to provide adequate water temperatures for anadromous fish.***
Type: Administrative
Cost: No estimate
Status: In progress by Yuba River Temperature Advisory Committee.
Partner: CDFG, Yuba County Water Agency, SWRCB, USFWS
Source: USFWS 1995
- A Inventory all water diversions in the drainage from Englebright Dam to the Feather River.***
Type: Evaluation
Cost: Estimate \$25,000
Status: No action.
Partner: CDFG
Source: CDFG 1993
- A Evaluate the effectiveness of pulse flows to facilitate the successful juvenile salmonid emigration.***
Type: Evaluation
Cost: No estimate
Status: No action.
Partner: USFWS, CDFG
Source: USFWS 1995

Special Report to the Fish and Game Commission

Priority

Action

- A** *Evaluate whether enhancement of water temperature control via shutter configuration and present management of the cold water pool at New Bullards Bar Dam is effective, and modify the water release outlet at Englebright Dam if it is effective.*

Type: Evaluation

Cost: No estimate

Status: No action.

Partner: Yuba County Water Agency, USACOE

Source: USFWS 1995

- A** *Evaluate the benefits or restoring stream channel and riparian habitats of the Yuba River including the creation of side channels for spawning and rearing habitats of salmonids.*

Type: Evaluation

Cost: No estimate

Status: No action.

Partner: CDFG

Source: USFWS 1995

SACRAMENTO-SAN JOAQUIN RIVER DELTA

The Delta roughly corresponds to the triangular area formed by the cities of Sacramento, Stockton, and Collinsville. The northern Delta is that portion dominated by waters of the Sacramento River. The western Delta is the area near the confluence of the Sacramento and San Joaquin rivers and is subject to the greatest tidal effects. The southern Delta is dominated by San Joaquin waters, the eastern Delta is dominated by the Cosumnes and Mokelumne rivers, and the central Delta is poorly defined but includes the myriad of intricate waterways between the Sacramento River and the lower San Joaquin River.

SACRAMENTO-SAN JOAQUIN RIVER DELTA-

Actions to Protect and Recover Spring-run Chinook Salmon

Priority	Action
A	<i>Close Delta Cross Channel (DCC) up to 45 days in November through January period, when juvenile salmon enter the Delta or flow or turbidity changes trigger salmon migration.</i> Type: Administrative Cost: No estimate Status: Guidelines being developed as part of Delta Accord/WQCP, implemented in 1995-1996. Partner: CALFED, Multi-Agencies through Ops Group Source: USFWS 1995
A	<i>Make operational changes in flow or export rates, or both, to prevent juvenile chinook salmon from being diverted to the southern Delta when the DCC is closed in the November through January period.</i> Type: Administrative Cost: No estimate Status: Proposal being developed as part of Delta Accord/WQCP; needs to consider migration timing of spring-run chinook salmon. Partner: CALFED Agencies through Ops Group Source: USFWS 1995
B	<i>Minimize fish loss and predation at facilities by operating state and federal pumps interchangeably.</i> Type: Administrative Cost: No estimate Status: Proposal being developed as part of Delta Accord/WQCP. Partner: CALFED Agencies through Ops Group Source: USFWS 1995
A	<i>Implement actions to reduce losses of juvenile anadromous salmonids resulting from unscreened or inadequately screened diversions in the Sacramento-San Joaquin Delta and Suisun Marsh.</i> Type: Administrative Cost: No estimate Status: Proposal being developed as part of Delta Accord/WQCP. Partner: CALFED Agencies through Ops Group Source: USFWS 1995

Priority

Action

B Provide funding for increased enforcement of fishery regulations in the Delta.

Type: Administrative

Cost: \$600,000/year

Status: Delta Bay Enhanced Enforcement Program in place (CDFG).

Partner: CALFED Agencies, USBR, CDWR

Source: USFWS 1995

A Evaluate opportunities to provide modified operations and a new or improved control structure for the DCC and Georgiana Slough or other methods at those locations to assist in the successful migration.

Type: Evaluation

Cost: No estimate

Status: Proposal being developed as part of Delta Accord.

Partner: SWP and CVP contractors, IEP agencies

Source: USFWS 1995

A Evaluate alternative water conveyance and storage facilities for the SWP and CVP in the Delta to avoid or minimize adverse effects on anadromous fish.

Type: Evaluation

Cost: No estimate

Status: Proposal being developed as part of Delta Accord and CALFED Bay-Delta Program

Partner: SWP and CVP contractors, IEP agencies, CALFED Bay-Delta Program.

Source: USFWS 1995

B Evaluate benefits of DCC closure to anadromous fish relative to time of day and tidal stage.

Type: Evaluation

Cost: No estimate

Status: Proposal being developed as part of Delta Accord.

Partner: SWP and CVP contractors, IEP agencies

Source: USFWS 1995

A Evaluate opportunities to create tidal shallow-water habitat to increase rearing habitat for anadromous fish in the Delta.

Type: Evaluation

Cost: No estimate

Status: Proposal being developed as part of Delta Accord.

Partner: SWP and CVP contractors, IEP agencies

Source: USFWS 1995

C Evaluate feasibility of Delta channel barriers and other technologies to improve water quality and to guide migrating fish.

Type: Evaluation

Cost: No estimate

Status: Proposal being developed as part of Delta Accord.

Partner: SWP and CVP contractors, IEP agencies

Source: USFWS 1995

Special Report to the Fish and Game Commission

Priority

Action

- A** *Evaluate riparian restoration opportunities, such as conservation easements, that are coordinated with restoration of rearing habitats and consistent with flood control and other objectives.*
Type: Evaluation
Cost: No estimate
Status: Proposal being developed as part of Delta Accord.
Partner: Local interests, SWP and CVP contractors, TNC, IEP agencies
Source: USFWS 1995
- A** *Evaluate opportunities to improve water quality, riparian and rearing habitats, and reduce the number of Delta diversions through land retirement and consolidation of diversion points.*
Type: Evaluation
Cost: No estimate
Status: Proposal being developed as part of Delta Accord.
Partner: Diversifiers, Landowners, IEP agencies
Source: USFWS 1995
- A** *Evaluate opportunities to develop channel buffer zones to enhance riparian areas and reduce sedimentation.*
Type: Evaluation
Cost: No estimate
Status: Proposal being developed as part of Delta Accord.
Partner: Diversifiers, Landowners, IEP agencies
Source: USFWS 1995
- C** *Evaluate effects of pulse flows on chinook salmon migration.*
Type: Evaluation
Cost: No estimate
Status: Proposal being developed as part of Delta Accord.
Partner: SWP and CVP contractors, IEP agencies
Source: USFWS 1995
- A** *Evaluate actions to reduce loss and entrainment of eggs, larvae, and juveniles of anadromous fish by screening or relocating riparian diversions in the Delta.*
Type: Evaluation
Cost: No estimate
Status: Proposal being developed as part of Delta Accord.
Partner: CDFG, CDWR, USFWS, USBR
Source: USFWS 1995
- A** *Evaluate potential means of measuring of Delta hydraulic conditions.*
Type: Evaluation
Cost: No estimate
Status: Proposal being developed as part of Delta Accord.
Partner: SWP and CVP contractors, IEP agencies
Source: USFWS 1995
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CENTRAL VALLEY (GENERAL)- Actions to Protect and Recover Spring-run Chinook Salmon

Priority	Action
B	<i>Support programs to provide educational outreach to local communities, including programs like Salmonids in the Classroom, Aquatic Wild, and Adopt a Watershed.</i> Type: Administrative Cost: No estimate Status: Proposal being developed as part of Delta Accord. Partner: Local schools, CDFG, USFWS, NMFS Source: USFWS 1995
A	<i>Evaluate the potential to modify hatchery procedures to benefit native stocks of salmonids.</i> Type: Evaluation Cost: No estimate Status: Proposal being developed as part of Delta Accord. Partner: CDFG, USFWS Source: USFWS 1995
A	<i>Evaluate and implement specific hatchery spawning protocols and genetic evaluation programs to maintain genetic diversity in hatchery and natural stocks.</i> Type: Evaluation Cost: No estimate Status: Proposal being developed as part of Delta Accord. Partner: CDFG, USFWS Source: USFWS 1995
B	<i>Evaluate a program to tag and fin-clip all or a significant portion of hatchery-produced fish as a means of collecting better information regarding harvest rates on hatchery and naturally produced fish and effects of hatchery-produced fish on naturally produced fish.</i> Type: Evaluation Cost: No estimate Status: Proposal being developed as part of Delta Accord. Partner: CDFG, USFWS Source: USFWS 1995

Special Report to the Fish and Game Commission

OCEAN - Actions to Protect and Recover Spring-run Chinook Salmon

Priority

Action

- A** *Evaluate the need to revise harvest regulations on both sport and commercial fishers to increase spawning escapement of naturally produced chinook salmon.*

Type: Evaluation

Cost: No estimate

Status: Proposal being developed as part of Delta Accord.

Partner: CDFG, PFMC

Source: USFWS 1995

- C** *Evaluate the effects of foreign, open-ocean harvest on Central Valley chinook salmon and steelhead stocks.*

Type: Evaluation

Cost: No estimate

Status: Proposal being developed as part of Delta Accord.

Partner: CDFG, NMFS, USFWS, PFMC

Source: USFWS 1995

Ocean